DOCUMENT RESUME

ED 277 619 SO 017 764

AUTHOR	Kent, W. Ashley, Ed.
TITLE	The Use of Computers in the Teaching of Geography.
INSTITUTION	London Univ. (England). Inst. of Education.
REPORT NO	ISBN-0-85473-258-6
PUB DATE	86
NOTE	210p.; Edition prepared for the 1986 International Geographical Union Regional Conference (Sitges, Spain, August 1986).
PUB TYPE	Reports - Descriptive (141)
EDRS PRICE	MF01/PC09 Plus Postage.
DESCRIPTORS	*Computer Assisted Instruction; Computer Literacy; Computer Uses in Education; Elementary Secondary Education; Foreign Countries; *Geography; *Geography Instruction; *International Programs; *Microcomputers; Resource Materials; Teaching Methods

ABSTRACT

Eleven essays describe state of the art developments in the use of computers and computer-assisted learning to teach geography. Descriptions of the use of computers in the teaching of geography in their respective countries are contributed by educators from the United Kingdom, Italy, Belgium, The Netherlands, Australia, New Zealand, Scotland, United States, USSR, Hong Kong, and Canada. The contributors were asked to summarize recent developments; outline hardware and software trends; note the response of teachers in using computers; outline the research needs; and give insight into the future. It is hoped this publication will point to future collaborative research and development possibilities for the international community of geographical educators. (APG)

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THE USE OF COMPUTERS IN
THE TEACHING OF
GEOGRAPHY

Edited by

W. Ashley Kent

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ISBN : 0 85473 258 6

Published by University of London
Institute of Education

1986

CONTENTS

		Page
Introduction	Ashley Kent	7
The State and Development of the Use of Computers in the Teaching of Geography in Italy	Alberto Agosti and Francesca Gobbo	9
The State of Development of the Use of Computers in the Teaching of Geography	Marc Antrop	33
Dutch Geography and CAL Developments	Jan Van Beckum and Henk Trimp	45
The Use of Microcomputers in the Teaching of Secondary School Geography in Australia	Colin Davey	65
Computer Based Education in Geography in New Zealand	Pip Forer	93
CAL and Geography in Scotland	Dick Jennings	117
The Use of Computers in the Teaching of Geography in England	Ashley Kent	147
School Geography and Computer Assisted Learning in the United States from Simulations to Data Bases	James Marran Jo Stoltman and Nickolas Liolios	165
The Usage of Computers in Teaching Geography in the USSR	Lydia Pancheshnikova	187
The Development of CAL in Hong Kong	Philip Stimpson	193
Computer Use in Geographical Education in Canada	Jo Ann Wilton	211

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INTRODUCTION

At it's last meeting in Paris in August 1984 the Commission on Geographical Education asked me to co-ordinate and edit this publication for the 1986 IGU Regional Conference to be held in Sitges, Spain in late August. Through the Commission Newsletter and personal correspondence, invitations to contribute were aimed at those people known to be interested in this area of education. The intention is to describe the 'state of the art' in computer assisted learning in geography across a range of countries. Contributors were asked to:- summarise recent developments; to outline hardware and software trends; note the response of teachers; outline the research needs; and give a glance to the future. The hope is that this publication alongside the earlier one, (Graves, 1984) will point to future collaborative research and development possibilities for the international community of geographical education. As I have recently learned from an International seminar I organised here at the Institute of Education, the benefits of such international exchanges and ventures can be considerable (Kent, 1986).

My thanks go to the fourteen authors and co-authors of the papers; to Jo Stoltman, Chairman of the Commission on Geographical Education for his support and encouragement; Geoff Fitch and staff who organised the printing; and as usual not least to Chris Chitty and Margaret Clements for their excellent typing.

W. Ashley Kent

August 1986

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THE STATE OF DEVELOPMENT OF THE USE OF COMPUTERS IN THE TEACHING OF GEOGRAPHY IN ITALY

Alberto Agosti and Francesca Gobbo

Italy

As computers have only recently arrived and gained acceptance in Italian schools, collecting information on this topic has proved somewhat difficult. The data available is scanty and mostly descriptive, indicating that the introduction and the use of computers in the construction and implementation of curricula have so far been promoted by the singlehanded initiative of teachers and school principals.

However, recently the picture has changed because of the official stance taken first by CEDE [Centro Europeo dell 'Educazione/European Centre for Education] and by the Italian Ministry of Education, subsequently, in the direction of computer assisted learning.

A brief summary of the state of the art, before the launching of the above mentioned projects, will be given in order to allow a better understanding of the present situation and of the problems it involves.

Since the end of the sixties, Italian educators have become interested in computer science, realising its suitability for learning and cognitive processes. As a topic, computer science was experimentally introduced in a limited number of schools in 1967-68. In relation to this, two new professional qualifications were established by the Italian Ministry of Education at high school level: a computer science engineering diploma [diploma di perito informatico] and a computer science accountant diploma [diploma di ragioniere programmatore].

Following the rapidly booming success of home and personal computers at the end of the seventies, computer science had to be reckoned with, while its relevance for education became more and more widely acknowledged, especially since young people all over the world were quick to appreciate the multiple roles computers could play in their lives.

Meetings and conferences on the use of computers have been increasing since 1983 and so have classes (mostly taught in private schools) on "how to deal with PCs". Also, since then, at compulsory school level and high school level experimental courses have been set up where computer assisted learning has taken place. Taking notice of such a momentous change, the new elementary school programmes, to be enacted by 1987, state the possibility of constructing and analysing procedures and algorithms (both numerical and otherwise) through the initial use of computer assisted teaching suited to the age and to the problems this involves.

The need for educational intervention covering both primary and secondary school, in the field of computer science, has been heeded by CEDE, prompting the IRIS Project [Iniziative e Ricerche per l'Informatica nella scuola/ Initiatives and Researches for Computer Science in School] which was approved and financially backed by the Ministry of Education. The purpose of the IRIS Project is the introduction of computer science and computer technology in basic and general education. More specifically IRIS is aimed at:

- testing an organised set of instructional units elaborated by expert teachers;
- carrying out a series of surveys and investigations on the effects of computer science and technology applied to school curricula. It is foreseen that the instructional units will concern elementary school children (age 6 to 10), junior high school pupils (age 11 to 14) and high school freshmen and sophomores.

The basic idea underlying the IRIS Project is that such instructional units will be part of (i.e. be inserted in) otherwise "traditional" subject matters. This in turn should result in a learning experience which aims at enhancing the pupils' abilities for problem description, representation, communication and solving rather than at the acquisition of a specific competence in computer science and programming.

Even more recently, the Italian Ministry of Education launched a General Plan for introducing, at the national level, computer science in high *schools, thus officially indicating that the Italian school can no longer ignore what has already deeply affected not only the economy and industry of the nation, but also society at large. One has only to browse through advertisements in major national magazines and newspapers to realise that.*

The major objective of the Plan (Phase 1) is the training of computer science educators who will subsequently train teachers locally. The fact that the training is carried out by four national centres which are better known for their concern and long experience in business training rather than in educational and instructionalresearch has provoked some discussion. The decision taken by the Ministry of Education, however, could be read as a sign of how the relation between computer science and education is still open to debate and interpretation, and is far from being firmly established.

On the one hand, computer science supporters emphasize that students and teachers alike need to learn to deal effectively with computers and need a full awareness of them. They suggest that educational efforts and investments be focussed on this objective.

On the other hand, the champions of the integration of computer science with "traditional" scholastic subject matters, i.e. computer assisted teaching and learning, favour the introduction and use of computers in school solely as means of instruction. In addition to this, they point out the educational advantages brought about by an approach that fosters problem solving abilities through the use of computers rather than by one centred on the teaching and learning of computer programming techniques.

Philosopher of education Mauro Laeng, who teaches at Rome University and has always concerned himself with the relationship between education and technology, specifies that education will benefit from the integration of computer science with school curricula, because such a science makes necessary:-

- a close analysis of the steps through which we build our own way of reasoning, thereby enabling us to single out and locate any ambiguity or misunderstanding that might have slipped in, and
- it furthermore requires that the logical sequence be reformulated in a synthetic form. It should be added that Mauro Laeng considers the notion of computer assisted instruction as evolving from that of programmed learning, rather than in opposition to the latter, even though he recognizes the former to be a great intellectual challenge and attributes a higher degree of flexibility to it, especially since its procedures keep pace with the pupils' learning processes.

A Survey of Computer Using in Italian Schools (after G. Biondi & P. Gabbrielli, "Dati relativi al computer nella scuola", in Annali della Pubblica Istruzione, XXXI, n. 4, Luglio-agosto 1985).

The following data are part of a Ministry of Education survey of Italian schools that was carried out with the purpose of discovering the state of play of computers and schools during the period May-June 1984.

Questionnaires were sent to all the schools, 78.7% of which returned them duly completed. More specifically there were 81.5% returns from elementary schools, 79.8% from junior high schools and 74.0% from high schools.

The last percentage can be further subdivided among classical high school (77.2%), technical high school (78.8%), professional high school (66.7%) and art high school (65.4%).

With reference to the schools which answered the questionnaires, there was a total of 1,152 home computers (i.e. with no floppy disc), 1,120 of which were in use; 3,020 personal computers (with floppy disc), 2,946 of which were in use; 1,486 computers running both on tape and/or disc, 1,410 of which were in use; 271 terminals, 254 of which were in use. The total of computers in Italian schools comes to 5,929, a number that can be further subdivided among elementary, junior high and high schools. (see Table 1)

TABLE 1

	Personals (without floppy disc	Personals (with floppy disc	Computers (tape &/or floppy disc	Terminals	Total
Elementary school	71	38	47	24	180
Junior high school	393	106	144	37	680
High school	688	2876	1295	210	5069
Totals	1152	3020	1486	271	5929

(op.cit., p. 432)

As the data refer to the total of computers in Italian schools, they include those not in use as well.

We can see that 1.6% of elementary schools own a computer. In geographical terms this means 2.3% of elementary schools in Northern Italy, 1.9% in Central Italy, 1.0% in the South and 1.2% in the islands.

With regard to junior high schools, in Northern Italy 8.7% of them has a computer, while for the other parts of the country the percentages go down to 4.3% (Central Italy), 1.3% (in the South) and 1.7% in the islands.

The highest percentages of schools owning a computer are to be found at high school level: in Northern Italy 41.3%, 37.5% in Central Italy, 25.6% in the South and 23.1% in the islands. Considering high schools by sectors, we find that 15.2% of Classical high schools have computers, while the percentage of Professional high schools is 34.8%. The percentage of schools where there are computers soars to 57.6% when we come to Technical high schools and goes down to 14.0% with art high schools. If we compare the school with the instructional use to which the computer is put, we notice that teachers use computers for mathematics instruction most frequently. (see Table 2)

TABLE 2

	Language & Literature	Mathematics	Interdisciplinary activities	Extramural activities
Elementary school	12.3%	21.9%	21.9%	2.7%
Junior High school	12.7%	55.4%	27.1%	4.8%
High school	3.6%	76.3%	19.1%	5.3%

(op.cit., p. 434)

This holds true for the different sectors of high schools as well (see Table 3).

TABLE 3

	Language & Literature	Mathematics	Interdisciplinary activities	Extramural activities
Classical High School	6.7%	78.4%	21.6%	4.3%
Technical High School	3.6%	75.7%	22.7%	5.0%
Professional High School	0.9%	79.6%	10.7%	6.1%
Art High School	16.0%	32.0%	16.0%	12.0%

(ibid.)

The survey aimed at knowing if, and how much, teachers did object to computers. The greatest objections came from elementary school teachers, as Table 4 shows.

TABLE 4 Do you object to using computers in school?

	NO	YES
Elementary school	89.0%	11.0%
Junior High School	96.0%	4.0%
High school	98.1%	1.9%
Totals	97.3%	2.7%

(op.cit., p. 435)

The teachers' attitude to computers can be best seen at high school level (see Table 5). It should however be added that the survey indicated that teachers made fewer objections to computers than to other audiovisual teaching aids.

TABLE 5

	No objections	Objections
Classical High School	98.1%	1.9%
Technical High School	98.5%	1.5%
Professional High School	97.7%	2.3%
Art High School	96.0%	4.0%
Totals	98.1%	1.9%

(ibid.)

From what has so far been said, it appears that educators agree to make way for computers in school as long as they support and enhance educational formative values, while there is a tendency to consider professional competence and training in computer science and technology as an altogether separate question.

The educators' interest in and eagerness for approaches and tools able to bring about effective changes in curricula, teaching and learning has up to this point been somewhat checked by the awareness that mere introduction of computers in schools can simply be a way to pay lip-service to innovation. The status quo reasserts itself apart from the clutter of hardware.

At this stage, the crucial role played by computer software can in no way be underestimated, not only with regard to the attainment of educational aims, but also, and most especially, for winning and sustaining teachers' confidence in better teaching and learning through the use of computers and computer software.

The use of software in connection with the teaching of geography should hopefully provide a good opportunity for a change in teaching strategies which, unlike other subjects, underwent few improvements in spite of the significant advancements in the field of the epistemology of geographical research.

The most interesting software considered here tends to emphasize the interdependent relation within the environment and which causes its evolution in time. Pupils have thus the chance to become aware of the dynamic determinants of environmental change and to grasp the relevance of timely human intervention to maintain the balance of the environment or, on the opposite, the environmental deterioration and pollution which people have brought about.

Software

Little quality software for the teaching of geography exists at present in Italy, where the situation is particularly difficult as there are few available programs which are also valid in terms of acceptable teaching strategy. The data given here is a selection of the most interesting material in the field of geography teaching.

It should be noted that some of it is an Italian version of English software.

Title: GEOGRAFIA III ELEMENTARE School age: 8
(Elementary School Geography)
Manufacturer: PHILIPS (Milano)

Year of production: 1985 **Price*:** L. 38,000

Hardware: MSX

Format and documentation: 1 floppy disk 2.8

Description: Lessons, exercises and maps for elementary school on the topic of hills, sea, river , mountain and plain.

* in Italian lire

Title: GEOGRAFIA IV ELEMENTARE School age: 9
(Elementary School Geography)
Manufacturer: PHILIPS (Milano)

Year of production: 1985 **Price*:** L. 38,000

Hardware: MSX

Format and documentation: 1 floppy disk 2.8

Description: Lessons, exercises and maps for elementary school on the topic of Italy and Italian provinces.

* in Italian lire

Title: GEOGRAFIA V ELEMENTARE School age: 10
(Elementary School Geography)
Manufacturer: PHILIPS (Milano)

Year of production: 1985 Price*: L. 38,000

Hardware: MSX

Format and documentation: 1 floppy disk 2.8

Description: Lessons, exercises and maps for elementary school on the topic of Continents.

* in Italian lire

Title: TOPOGRAFIA EUROPEA School age: 10
(European Topography)
Manufacturer: COMMODORE ITALIANA (Milano)

Year of production: 1985 Price*: L.10,000

Hardware: COMMODORE

Format and documentation: 1 cassette

Description: Through a simulated helicopter flight the pupil learns to locate the site of European capitals.

* in Italian lire

Title: MALTHUS (+) **School age:** 14/16

Manufacturer: MONDADORI Edizioni elettroniche (Milano)

Year of production: 1985 **Price*:** (+)

Hardware: SPECTRUM/ COMMODORE

Format and documentation: (+)

Description: History of past and present overpopulation trends with projection for the future.

* in Italian lire

Title: VILLAGGIO (Village) (+) **School age:** 11/14

Manufacturer: MONDADORI Edizioni elettroniche (Milano)

Year of production: 1985 **Price*:** (+)

Hardware: SPECTRUM/ COMMODORE

Format and documentation: (+)

Description: A simulation of a hunter and farmer settlement: energy optimization and its evolution in time.

(+) Together with other ones, these programs are included in Il software per la scuola by C.Rovelli, D.Casati, E.Rovelli, Edizioni elettroniche Mondadori (Milano) (Direction book for teachers and pupils and 1 cassette) Price: L. 35,000.

* in Italian lire

Title: PIANETA '84 (Planet '84) School age: 11/16

Manufacturer: NUOVA CEI INFORMATICA (Milano)

Year of production: 1984 Price*: L.400,000 + 100,000 (for yearly updating material)

Hardware: OLIVETTI M 24 MS DOS

Format and documentation: 12 floppy disks and 4 integrative volumes

Description: Data base on world geography.

* in Italian lire

Title: LE REGIONI D'ITALIA (Italian provinces) School age: 11

Manufacturer: PARAVIA-RICORDI (Torino)

Year of production: 1985 Price*: L.25,000

Hardware: ACORN BBC

Format and documentation: 1 cassette and direction booklet

Description: Lessons, exercises and maps for junior high school on the topic of Italian provinces.

* in Italian lire

Title: MERIDIANI E PARALLELI (Meridians and parallels) School age: 11/14

Manufacturer: PARAVIA-RICORDI (Torino)

Year of production: 1985 Price*: L.25,000

Hardware: ACORN BBC

Format and documentation: 1 cassette and direction booklet

Description: Lessons and exercises on the topic.

* in Italian lire

Title: ISTOGRAMMI (Histograms) School age: 11/14

Manufacturer: RISORSE PER LA DIDATTICA (+) (Milano)

Year of production: 1984 Price*: L.15,000 (1 cassette)

Hardware: SPECTRUM/COMMODORE

Format and documentation: (+)

Description: Using the data found in geographical books, a double entrance table is laid out where the data can be inserted in groups in order to produce the graphic representation by histograms on the video and/or on the printer. The pupil formulates hypoteses on correlations and draws histograms to support his theses.

(+) This and other programs are described in the book DAL LIBRO DI TESTO ALL'USO DELLO SPECTRUM E DEL COMMODORE by JACKSON, Milano (1985). Software can be bought separately.

* in Italian lire

Title: IL CLIMA (Climate) (+) **School age:** 14/16

Manufacturer: PARAVIA-RICORDI (Torino)

Year of production: 1985 Price*:L.50,000

Hardware: ACORN BBC, OLIVETTI M 24, IBM PC, IBM COMPATIBLE

Format and documentation: 2 floppy disks $5\frac{1}{4}''$ and 1 direction book

Description: The unit offers the pupil graphics and tables on temperatures and precipitations in definite geographical zones, so that he can recognize the several kinds of climate on earth.

(original title: CLIMATE by Heinemann Computer in Education-London)

(+) The Italian version of this unit, together with other ones from England, has been made to by DIDA.EL S.r.l. (Milan).

* in Italian lire

Title: ACQUA E TERRA (+) **School age:** 15/17

Manufacturer: PARAVIA-RICORDI (Torino)

Year of production: 1985 Price*:L.50,000

Hardware: ACORN BBC, OLIVETTI M 24, IBM, IBM compatible.

Format and documentation: Floppy disk $5\frac{1}{4}''$ and direction book

Description: The unit allows rain absorption simulations; the pupil can change the contexts by modifying some parameters (season, climate, et cet.).

(+) Original title:WATER ON THE LAND by Longman Micro Software-Harlow.

* in Italian lire

Title: CHE TEMPO FA (+) School age: 11/14

Manufacturer: PARAVIA-RICORDI (Torino)

Year of production: 1985 Price*:L.50,000

Hardware: ACORN BBC, OLIVETTI M 24, IBM, IBM compatible

Format and documentation: Floppy disk 5 $\frac{1}{4}$" and direction book

Description: The unit aims at guiding the pupil to interpret weather-maps and, by so doing, to make weather-forecast.

(+) Original title: WEATHER by Heinemann Computers in Education-London.

* in Italian lire

Title: COMPRENDERE LA CARTOGRAFIA 1 E 2 (+) School age: 11/14

Manufacturer: PARAVIA-RICORDI (Milano)

Year of production: 1985 Price*:L.100,000

Hardware: ACORN BBC, OLIVETTI M 24, IBM, IBM compatible

Format and documentation: floppy disks 5$\frac{1}{4}$" and direction book

Description: The unit aims at guiding the pupil to read and interpret geographical maps and to learn how to use the compass.

(+) Original title: INTRODUCING MAP SKILLS 1/2, Cambridge Micro-Software.

* in Italian lire

Title: **L'incremento demografico** School age: **14/16**

Manufacturer: **Paravia-Ricordi** (Torino)

Year of production: 1985 Price*: L.50,000

Hardware: **Acorn BBC, Olivetti M24, IBM, IBM Compatible**

Format and documentation: **Floppy Disk 1/4" and Direction Book**

Description: **Population growth is here presented in relation to birth and death rates.**

Original title: Population growth by Cambridge MICRO Software.

* in Italian lire

Title: **Astronomia 1 (Astronomy 1)** School age: **11/18**

Manufacturer: **Olivetti** (Ivrea)

Year of production: 1985 Price*: **not listed**

Hardware: **Olivetti M24**

Format and documentation: **not listed**

Description: **The unit aims at guiding the student to a good understanding of some simple astronomic phenomena.**

* in Italian lire

Title: Moti planetari (The Motion of the Planets)   School age: 15/18

Manufacturer: Olivetti

Year of production: 1985   Price*: not listed

Hardware: Olivetti M24 MS DOS

Format and documentation: not listed

Description: The unit aims at a deeper understanding of the laws of universal gravitation and at the interpretation of a whole gravitational system.

* in Italian lire

We think it right to give some information about two units which will be published by Petrini (Torino) in 1986. The authors, geography professors Claudia Binelli and Carla Lanza Dematteis, and software expert Agnello Pepe, prepared an outline which proved very useful for our present contribution.

The first unit, entitled un archivio dati per la geografia (A Geographical Data Base) is suitable for high school pupils. Besides introducing the concept of statistical indicators and their use for geographical research, the unit has an operative section for data base management on the Italian provinces, the European States and the fifty States of the USA. The branched structure of the unit gives both the opportunity to locate the already memorized information and to insert and/or to modify the data, thus regularly updating the program at the same time.

The unit offers the methods of scientific geographical research rather than giving solely specific geographical notions. All the practical exercises are open-ended and pupils are encouraged to store and search for data. Beside this, the understanding of the branched structure of the data base encourages the handling of information through computers.

The second unit, Introduzione alla geografia quantitativa, l'uso dei dati statistici (Introducing Quantitative Geography, Statistical Data Use), is also suitable for high school students and for those, geography teachers who do not consider this science as exclusively descriptive, and want to introduce modern methods of geographical research in their teaching activities. In particular, the unit introduces analytical-quantitative geography, making use of standard geographical procedures. Besides the graphic presentation of data, the program offers the opportunity to draw cartograms for a set of established data bases. The last part of the unit introduces the concept of rank-dimension, employed in geography to study urban networks.

The program can be used in two different ways: as a methodological itinerary offered by the software, or as an aid to a research study of regional geography.

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THE STATE OF DEVELOPMENT OF THE USE OF COMPUTERS IN THE TEACHING OF GEOGRAPHY

Marc Antrop

Belgium

In Belgium, the introduction of the microcomputer in education has been on the initiative of individual teachers experimenting with their own computers. They shared their problems through users clubs. Some of them tried to sell their programs through the editors of schoolbooks. The computers used were mainly Tandy and Apple. In 1981 the SCHOOL & COMPUTER SOCIETY was founded, consisting mainly of teachers in mathematics and languages. Their aims were the exchange of ideas and problems, the development of a database of the software produced in Belgium advising on the school situation and the creation of a large number of small and 'unofficial' working groups. These consisted mainly of teachers working on other micros. The society has about 500 members and organizes an annual symposium. Its importance as an official body decreased rapidly in the last few years in favour of the users groups around new micros (e.g. Commodore 64) and the fact that each discipline, including geography, formed its own working groups of teachers.

These spontaneous developments were faster and even more coordinated than the official initiatives from the different school institutions (public and private), in the different parts of Belgium (Flanders, Walloon country). The latter are restricted to some support in hardware and recommendations, both characterized by the lack of long-term vision and inadequate effort.

Hardware

The first computers used in the schools were the Tandy TRS80 and to a lesser extent the Apple. In the beginning of the eighties, the Apple II was promoted by the Ministry of Education and each public (school group) received just one micro. Thus some kind of 'Apple' standard was installed. Private schools made their own choice resulting in a greater diversity of computer types. In the period of 1980-84 the Dai, the only Belgian computer has been more or less successful, but bad management made any follow up difficult. The rapid success of the Commodore 64 makes it the most widely distributed home computer at this moment. It also made the use of a micro popular by the children and by a large number of teachers. Private funds were raised by school-boards and parents' committees to extend the computer facilities in the schools and consequently the not so expensive Commodore 64 invaded education too.

In 1984 the Ministry of Education and a public bank came to an agreement. They offered the specially made Philips micro to the primary schools. Although educational arguments had been used in the selection of this micro its use remains restricted to administrative purposes and no educational software has been supplied.

In 1985 some secondary schools received the status of pilot school for the preparation of the general introduction of the new discipline 'Informatica' in 1986-87. Meanwhile the hardware battle started again. At this moment there is an agreement to choose the MS-DOS standard. All public secondary schools will receive several of these machines, probably Olivettis. The price and the fact that almost no educational software is available, have not been taken into account in this selection. In the meantime, the teachers continue the development of software on their C64, Apple or any other cheap micro.

To summarize the situation: there are the following 'forces' acting upon the introduction of micros in Belgian education:

1. the Flemish and Walloon governments act independently;
2. the decisions of both Ministries of Education act directly upon the public schools;
3. no long-term policy in the field of micros and education is evident;
4. the majority of private schools, and mainly the catholic ones, have greater freedom and thus have chosen other computers than the ones selected for the public schools, resulting in a greater diversity in machines;

5. each school tries to present a 'high-tech' image to the parents. Consequently, the availability of micros in the school is regarded as a label of quality. To obtain these machines, school committees raised funds and mostly cheap micros with a wide range of educational possibilities and software have been purchased;
6. software is created mainly by the teachers themselves, using either their own micros or the school micros.

Software

The software available embraces mostly 'home-made' programs and some commercial software mainly of foreign origin and translated. The Flemish part of the country becomes more and more involved with the developments in The Netherlands and with British software. The Walloon part of the country has some contacts with the French.

After several years, the Flemish 'home-made' programs for geography became well known and have been centralised by the author in the University of Ghent. For the Walloon part of Belgium, this effort has only just started in 1985 and will probably be centralised at the University of Liège. Tables 1-3 give a review of the situation in Flanders in January 1986.

Table 1 shows the number of programs developed in Flanders for the different types of computer. This number has been weighted according to the proportion each micro is distributed in the schools, thus giving an index of potential software distribution. Commodore 64 and the Apple have the best position thanks to their common occurrence in the schools (each about 30%). The relative high proportion of software written for Dai (a Belgian micro) and BBC is mainly due to the local activities at the University of Ghent, using these micros. Their index of distribution remains low because of the low proportion (estimated 5%) of the occurrence of these micros in the schools. Although Tandy computers are well represented in the schools (about 20%), no educational software for geography is known to this author. The Msx micros are getting introduced and an important activity has been the creation of educational software in the Flemish as in the Walloon parts of Belgium.

According to the content of the programs, ten groups of geographical topics can be recognised (table 2). The most important groups deal with climatology, cosmology and cartography (group VI, VII, VIII). Almost every author of software has written a climatic classification program. This can be explained by the relative simple programming it demands. The same reason applies to the classic and important group I dealing with demography and population growth. The interest in enquiry oriented programs, which allow experimentation with information retrieval and manipulation of geographical data of a great variety, is very recent. In many cases no general database program is used, but programs in Basic are written and adapted to specific geographical needs, in particular with respect to the graphical representation of the data. Most of these programs are primarily meant as a tool for the teacher to illustrate lessons or to prepare the worksheets for the students.

The relatively small number of topics dealing with social and economic geography and spatial analysis, has to be explained by the fact that in the curriculum they are studied in a more static and theoretical way. Most teachers are still not aware of the advantages of a microcomputer in this field of simulation and modelling. Those who do, have difficulties or lack the programming ability to translate the algorithms into an educational program. The low score for the topics dealing with physical geography (excluding climatology) is also remarkable. Most of the teaching in this field remains descriptive and the rare fieldwork carried out is not supported by the use of micros. Third world countries and problems of underdevelopment are also poorly represented. The few programs which do exist compare countries using different variables (population, income,...) and presenting them in some graphic form.

According to the teaching methods used (table 3), we see that most programs combine different methods and a singletype is hard to find. In many cases they start with a demonstration and a small tutorial to 'refresh' the topic. For the drill and practice type, error analyses and feedback remain very elementary. The most important groups (I and III) are in fact tools for the teacher to elaborate on worksheets for the students and to illustrate the lessons. Simulation and gaming (groups V, VI) are poorly represented as could be expected from the topics dealt with.

The Response of the Teachers

Generally speaking, the response of geography teachers has been both limited and very hard to estimate. More and more there is evidence that a lot of teachers in geography are experimenting on their own, but do not wish or dare to present their efforts to their colleagues. Nor do they wish to get involved with any kind of organised working group. Most of them think that their work is not yet presentable or useful.

The first seminar for geography teachers, at the level of secondary education (12-18 years), was organised at the State University of Ghent (RUG) in 1984. The success of this seminar made it possible to produce a program for school television in 1985. Also in 1985 a working group was created at the private, Catholic University of Leuven (KUL), to prepare the popular in-service training seminars of the Vliebergh Sencie, mainly oriented at the private, catholic schools. These seminars, integrating the use of micros and video, will be held in 1986 and contributions of the State University of Ghent (RUG) and the ASCON working group of The Netherlands will be included. At the same time, about 10 teachers from the public schools were given a sabbatical year to investigate the developments of the use of the microcomputer in secondary geographical education. A working group was formed with the official inspectors, the State University of Ghent (RUG) and the Free University of Brussels (VUB). The work was organised in regional working groups of teachers and also some specialization occurred:

one group will develop new software in Basic on Apple and Commodore 64 computers; a second will analyse the possibilities of MS-DOS systems and author-languages such as PILOT; a third one will focus upon an inventory of the existing software and its educational evaluation.

Analogous activities in the Walloon part are - to my knowledge - restricted to the initiatives at the University of Liège, as well as by the society of their geography graduates (Association des Geographes de Liège). Also there is the Seminaire de Methodologie de la Geography. Their attention is focussed upon the development of software for Commodore 64 and MSX computers.

Research Needs

Research concerning the impact of microcomputers in geographical education has not yet started. Nevertheless, symposia and publications about the general use of micros in teaching are numerous. They rely upon evaluation of the existing software and upon a lot of philosophy. Empirical research is still lacking.

In the case of geography teaching such kind of research could be most useful. A first and urgent possibility would be the assessment of the impact of the home computer and 'home' education as a possible alternative way of geographical learning. Indeed, a lot of computer games aim to offer some educational value and very often present geographical concepts. The success of these games indicates that alternative interest exists but also that the possibile assimilation of geographical concepts can happen beyond the control of the teacher.

The Future

The future development of educational software for geography teaching will depend on the activities of the small group of teachers working on it, combined with coordination by the different universities. The options taken by the different school institutions and the government, although different, will not improve the possibilities in the field of geography. On the contrary, the choice of the MS-DOS standard and the introduction of the 'information technology' subject for all students, will reduce the time and the number of micros available for disciplines such as geography. Furthermore, it will be important for geographers to prove they are especially interested in this technology to keep the time available for geography at its present level in the curriculum. Therefore it is important to show that microcomputers in geography are not only an additional teaching tool, but are essential to some approaches to geography as a science as well. Examples which should be included in the curriculum are the use of models and simulations, computer cartography and geographical information systems.

Developments in the use of central databases such as Prestel (in the UK) or Viditel (in The Netherlands), as well as activities such as the Domesday Project cannot be expected in the near future.

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TABLE 1 : relative distribution (%) of the educational software made in Flanders for the different micros (a total of 81 programs in Jan. 1986)

Computer	% of available programs	potential distribution index (1)
APPLE	12	3.1
BBC-B	20	0.8
COMMODORE 64	17	4.3
DAI	30	1.3
TANDY TRS80	0	0.0
SINCLAIR SPECTRUM	7	0.2
PHILIPS P2000	0	0.0
MSX	14	0.3
MS-DOS	0	0.0

(1) index defined by the number of programs weighted by the proportion of the different computer types in the schools.

TABLE 2 : relative distribution (%) of the educational software made in Flanders according to the geographical topics (Jan. 1986)

Group	Geographical topics	%
I	Demography, population geography	11.3
II	Social Geography, spatial analysis, settlement geography, location theory	4.8
III	Economic geography, transport (road networks), tourism	4.8
IV	Regional geography, topography	9.7
V	Physical geography, geology, biogeography, ecology	8.1
VI	Climatology	16.1
VII	Mathematical geography, cartography	12.9
VIII	Cosmography, astronomy	12.9
IX	Third world problems	0.1
X	Information retrieval and manipulation	19.3

TABLE 3 : relative distribution(%) of the educational software for geography made in Flanders according to the teaching methods used (Jan. 1986)

Group	*Teaching methods used*	%
I	*demonstration, display*	*28.1*
II	*information retrieval and manipulation*	*6.7*
III	*calculating and drawing*	*23.6*
IV	*drill & practice*	*22.5*
V	*simulation*	*9.0*
VI	*gaming*	*4.5*
VII	*tutorial, programmed instruction*	*5.6*

DUTCH GEOGRAPHY AND CAL DEVELOPMENTS

Jan Van Beckum and Henk Trimp

Netherlands

Among areas of application for CAL, geography in the Netherlands is one of the leading subjects. Geography has caught the attention of policy makers, commercial publishers and educational institutions, and flourishes. Having its own finances in a national programme for expertise raising, geography is relatively independent.

This contrasts markedly with the early years of Dutch CAL. As early as spring 1983 a survey of CAL in Dutch geographical education, presented at the IGU conference on CAL in Geography (London, 1983) described the Dutch situation as follows:

- a cautious start has been made by a small group of geographers
- initiatives taken after British examples (working group ASCON, in service courses) set out some guidelines for geography teaching
- a growing interest in CAL applications shown by teachers and
- an absence of any recognisable structure in vision and policy for CAL demonstrated by the government.

As suggested above, the scene has now changed totally. The seed of the early pioneers has taken root in the fertile soil of keen geography teachers. The working group ASCON formed in February 1983 has been flooded with requests to do presentations, workshops, contributions to seminars and so on, and not only to satisfy geography audiences. The translation and recording of early British geography software (FARM GAME, WINDMILL) in combination with home produced programs formed the first generation of applications in the Dutch language for the most popular types of micro in the Netherlands. The enthusiasm of geographers and the growing number of publications about ASCON activities stimulated educational publishers to participate in the developments. In the meantime ASCON developed from an independent working group to one of the most active subject specific CAL working groups, brought together under the umbrella organisation Teachip (2).

After the difficulties of creating an organisational structure to meet the demands of an increasing number of new ASCON members on the one hand and the incessant flow of invitations to participate in CAL developments on the other, ASCON began to achieve maturity. Summer 1985 can now be mentioned as the breakthrough for geography as a CAL area, demonstrated by:

- dissemination of a reasonable number of geography programs in the Dutch language (table 1)
- explosion of geography software sales in contrast to preceding years (figure 1)
- introduction of the geographical search tree on Viditel, the Dutch public Viewdata system
- the financial support given to the Raamplan ISPAK by the government, to guarantee a three year programme for the raising of expertise in CAL geographers in the Netherlands
- the financial support for a number of in-service courses, as a part of the national Informatics Stimulating Programme (INSP)
- publication of the first two booklets on CAL geography in the Dutch language (van der Burg, 1985; van Beckum a.o., 1985)
- this breakthrough has continued through to early 1986.

The Situation in Schools

Hardware

In May 1985 the COI (Centre for Education and Information Technology) carried out research into the presence and use of computer equipment in all Dutch secondary schools.

It discovered that 74 per cent of these schools had one or more computers (compare 1981: 12.6 per cent and 1983: 39.8 per cent). Altogether there are 12,095 computers in 2,247 schools. It is significant for Holland that these are spread over more than 45 types of computers. The leader of the market is the Commodore 64 with 35 per cent, followed by the Philips P2000 with 17.7 per cent. The third up to and including the sixth in rank are Aster (5.9 per cent), Acorn BBC (4.9 per cent), Tandy TRS-80 (3.5 per cent) and Apple IIe (2.0 per cent). The Aster and the Philips (Dutch products) are relatively high in rank. This is caused by the only intervention of the Dutch government until May 1985, namely subsidizing these machines because of the 100-schools projects. In this project (1983-1985) approximately one hundred schools were given the opportunity to experiment for two years with standard configuration Philips or Aster computers.

Many schools which didn't take part in this project decided to procure computers of this type so as to gain advantage from the expected software supply. Caused by the limited potentialities of the P2000 (maximum 32K memory, low resolution graphics) and the early bankruptcy of Aster and the project did not lead toastandardization of equipment.

Software

The vast diversity of equipment in schools has particularly led to frustration for those teachers who wanted to use the computers in vocational education. Time after time they found that interesting software for their subjects could not be used in their schools.

We must add that, according to the earlier metioned COI research, the computers were used for CAL only 5 per cent of the time. The rest of the time was spent on computer sciences, in which there was an emphasis on programming skills (50 per cent of the time).

Teachers of subjects such as geography, history and languages, who until now strongly depended on programs from the U.K. often had to conclude that CAL had potential but that they could not realise it. The translation of a successful graphically oriented BBC program into a Philips P2000 is a practically hopeless task. Recently software in Dutch for the now available machines (particularly and simultaneous for the C64, the P2000 and also the BBC) has begun to be developed. Because of the lack of an umbrella organization like the CET in the U.K. these programs are often produced and distributed by authors under their own control. This usually does not encourage large scale production and distribution.

Information support

The teacher who seeks information about the potentialities of computer applications for his/her subject will find this in different bodies. The Teachip organisation, which is connected to the Teacher Training College SOL in Utrecht, has been the first national information centre to deal with just about everything on computers in education. For many years this organisation has functioned as a mother to the subject oriented working groups by administrative and financial support as well as by stimulating mutal contacts. Because of this, the now mature working groups could deal more and more with their subject oriented instruction in the form of seminars, workshops and in-service training.

For some years now educational publishers (Malmberg, Edukaboek) have functioned as de facto information centres too, related to the software they have developed. Still there is no nationwide management concerning the provision of information. This results in many telephone calls and references before the teacher seeking information is able to find an answer to his/her question.

Ongoing developments

In the situation as described above, a thorough change can be expected under the influence of the NIVO Project (New Information Technology in Secondary Education). This project was started by the Department of Education in cooperation with IBM, Philips and Tulip Computers. It aims at supporting all secondary schools with standard configuration IBM compatible equipment consisting of nine machines in a network and two single ones, from 1985 until 1988. Schools are strongly urged to link up with this choice for 16 bit MS-DOS apparatus (4). Alongside this an ambitious in-service programme was started for 90,000 teachers in total.

Since January 1986 an attempt has been made to organise the development of software in three places (the so called Ontwikkelpunten). In the meantime information for schools has been attended to by a network of Regional Keypoints Education and Information Technology Centres (RSOI) and the National Centre for Education and Information Technology (COI).

This Project fits into the Informatics Stimulating Programme of the Dutch government, which adopts a broader perspective, concerning the application of information technology in all sections of society.

The effect of the NIVO Project on Dutch geographical education is hard to estimate and it will depend on a number of aspects which may have great influence, such as:

- the exact specification of the hardware, especially regarding the graphical possibilities
- the capability of the (few) people at the development nodes, especially in education
- the contacts between the development nodes and the subject oriented working groups, needed for contributing subject content
- the opportunity for teachers to do in-service courses without these taking up too much free time

Even so, a growing interest in the development of software on IBM compatibles can be detected at universities and teacher training colleges. In the meantime more and more application possibilities for packages, are being researched, particularly in geography education.

Expertise raising

In a recent contribution to the international research seminar on CAL in the Social Sciences and Humanities (van Beckum, 1986) the author set out the central position of a national programme for expertise raising of CAL geographers in the Netherlands. As the title of that contribution suggests, it actually was the geographer's response to cope with a growing awareness of CAL capacities for geography and the absence of an example from any other subject to be modelled on. The so called Raamplan ISPAK was formed. From the government's point of view it is a worthwhile experiment, for geography it is a solid basis for continuing efforts on CAL applications. Raamplan ISPAK guarantees a 120 hours in-service course for representatives of all Teacher Training Colleges and Geographical

Institutes in the Netherlands on CAL in Geography during the years 1985-1987. Besides this it gives financial support to invite foreign CAL experts to come to the Netherlands. The network of relations that have been built in the last years has facilitated the realisation of this part of Raamplan ISPAK. The contribution of a dozen goegraphers from abroad to raising Dutch CAL expertise cannot be neglected.

Raamplan ISPAK serves as a reference for CAL policy in the Netherlands, even beyond the involvement of geography. Among the humanities it is used as a model for course development. For policy makers it is seen as a test case for organisational and financial consequences in the planning of the earlier mentioned nationwide in-service training programme that should reach 90.000 teachers. To some degree this desirable position raises expertise in itself.

The development of Educational Technology applications in Geography

The sequence of CAL activities is tuned into the planning of Raamplan ISPAK:

(i) Introduction to CAL in Geography
(ii) Courseware Development
(iii) Data Handling in Geography and
(iv) Computer Didactics in Geography Teaching.

Apart from organisational efforts to confirm ASCON as a working group, most activities have been concentrated on the development of a series of Dutch geography software to support (i) and (ii) in the last two years. About 30 titles are now available, a majority of which have been developed for just one type of micro. Even considering the variety of computer systems in schools the author suggests a critical minimum has been passed to stimulate geography teachers in the practice of CAL. However the choice of how and when to use geography courseware in the curriculum, seems to be restricted more by the hardware than by the available software.

The preparation of the in-service courses (iii) and (iv) involves a shifting of attention to these particluar items. The production of educational materials to this effect is expected in autumn 1986.

Courseware production in the Netherlands has gone through three stages.

I. Until summer 1983

This early stage was dominated by the delivery of geography programs designed by non-geographers or translated without the assistance of a geographer. Geography quizzes and drills (What is the capital of ..?) unsuccessfully tried to convince teachers of the potential of CAL for geography.

II. Summer 1983 until summer 1985

Private initiatives resulted in 'real' geography software: an experimental stage, more and more under the guidance of the working group ASCON, delivered a series of prototypes: simulations copied from British examples supported the first in-service training courses. Individual products reflected what CAL in geography could be: dialogues, games and simulations in whatever simple form. A collection of four programs (the so called ASCON disk) is characteristic of this period.

III. Summer 1985 until now

A variety of applications for a wide range of user groups began in 1985.

Educational publishers are developing the first generation of commercial products in cooperation with geography designers. Map skills training, third world enquiries, demography and simulations of various topics are filling the gap between geography teachers and the available hardware. Telesoftware and viewdata experiments are now broadening the view of teachers and pupils.

Until now three geography programs are distributed as telesoftware on Viditel, which is also being used as a databank for geographical information. A geographical search tree (Aardrijkskunde Zoekboom) facilitates information retrieval for educational purposes (figure 2) adding new classroom material. Retrieval figures show that this facility at least has provoked curiosity among a large group of Viditel subscribers, 400 of them being secondary schools.

Programs that resulted from ISPAK in-service training on courseware design (spring 1986) show considerable diversity, from the location of medieval castles to the behaviour of depressions in Western Europe and to the application of authoring systems. By the spring of 1986 over 30 geography programs have been distributed through institutions, individuals or publishers, twenty of them being available for the Commodore 64 (see figure 3 and table 1). This suggests that CAL in geography in the Netherlands is ready for take off (3).

Research

Research in the Netherlands in the field of Geography and Educational Technology is centred on two universities: The State University of Utrecht and the Free University of Amsterdam. More research in the scheme of courses and practical work is to be found at some teacher training colleges and secondary schools. This research is not formalised but it does come up *with interesting results.*

Under the influence of the national organisation for expertise raising a good integration of the several research projects has been achieved. The main study areas and related research projects are now described.

Geographical Courseware Design

At the State University of Utrecht there is work on the development of a strategy for GEOgraphical COurseware DEsign (GEOCODE). This design is based on an extensive comparative study of literature on design and development of CAL material and on the general Geography for Education model, which has been developed in the period of 1974 till 1984. In GEOCODE the structure of content is emphasized. The design of both a global and a refined information structure is an important stage in the strategy. Developing content applications in the direction of specific educational programs as well as in geographical information banks is within reach.

Information banks

In relation to the above-mentioned research design the working group Geography for Education (State University, Utrecht) is engaged in providing contents for existing information banks. In Viditel this is taking place with information on examination topics, developing countries, geography software and geographical concepts. Also datafiles are being constructed for a version in Dutch of QUEST in cooperation with AUCBE in Hatfield (U.K.). A cartographical extension for GRASS is to be developed with Newman College in Birmingham (U.K.).

A parallel research project is being carried out on the interaction between user and information bank. With the Department of Geography and the

Department of Psychology at the Free University in Amsterdam a user interface for information retrieval, with extensive help and explanation facilities, is being developed.

Simulations

In the Department of Geography at the Free University of Amsterdam, research is being conducted into learning by means of situational simulations. In this case pupils are being placed in a tangible decision making simulation in which they have an 'electronic reality simulator' at their disposal. Regarding the latter both regular databases and adventure-like programs are used. The research is looking at the search strategies developed by the pupils and their interference by means of structuring and interfacing the simulation. (Trimp, 1986)

Field responses

Such research is to do with:

a) the teacher and management role: currriculum responses (van Beckum, 1986) and

b) the pupil role: learning effects of the application of Information Technology.

As for the latter, research projects have taken place on existing software (E. Dieleman & H. Noltes, 1985) and projects which are directly related to the development of courseware (E. Jutten, 1985).

Future prospects

The global and the local perspective

Two trends can be identified in Dutch geographical education: on the one hand a growing emphasis on a global perspective and on the other hand a strong interest in the local environment, often combined with field research.

Thus a dual development of CAL applications can be predicted. From the global perspective there is a great need for on-line connections with international information banks. Standardisation of data formats is still a necessity to promote the development of these banks. Environmental education in schools and field research lead to a demand for software to store locally obtained information and to process it.

Expert databases

Because of the ever expanding memory and calculating capacity of micro-computers as well as the increasing familiarity with the attainments of artificial intelligence in education, the expert database will gradually come within reach.

In the next few years much attention will be given to the interaction between pupil and database. Several methods of training will be tested to determine their effect on learning behaviour. This also includes a renewed reflection on the question of what actually is the relevant geographical expertise to be built into the user-interface. In fact practically each form of geography simulation depends on a certain amount of data. Often this data has been selected and ordered for one specific simulation. Mostly data in such a simulation can only be retrieved in a rigid way. This development seems to be moving in the direction of a standard structure of the database itself, while in addition to this several possibilities are being created to communicate with the data. Therefore the database can show itself in different ways to the user.

Concluding remarks

Databases are likely to present an ever higher educational profile by the increasing accessibility of larger quantities of information for more and more user groups. This implies that geographical, cartographical and bibliographical information systems linked to educational application of remote sensing techniques will disclose a world of data. To use this in a satisfactory way, two types of skills will need further development:

a) the capacity to deal with data handling

b) the capacity to transform data into geographical information.

The latter type of skills in increasingly considered a problem in itself by geographers. In the next few years in Holland a lot of attention will be paid to these particular subjects. The development of a geographical information system for educational applictions (in Dutch: GISET) will support the research undertaken of this type at both the Universities of Amsterdam and Utrecht in the years 1987-1991.

Notes

(1) Acronym for Aardrijkskundige Soft - en Courseware Ontwikkeling Nederland i.e. Geographical Software and Courseware Development in the Netherlands.

Address: Archimedeslaan 16, P.O. box 14007, 3508 SB Utrecht,
Netherlands

(2) Foundation Teachip. Address: see note (1)

(3) Antrop (1985) published figures about 66 Dutch programs. In his article Antrop considered software from the Netherlands and the Dutch speaking part of Belgium as well. Our figures are restricted to programs made in Holland.

(4) In April 1986 rumours abounded that the final decision on the hardware specification would possibly change in favour of MSX computers.

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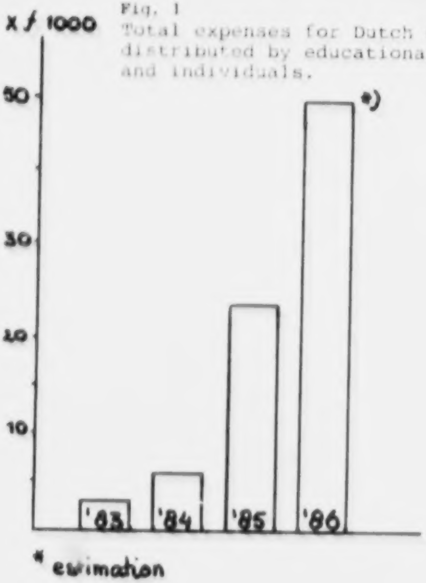
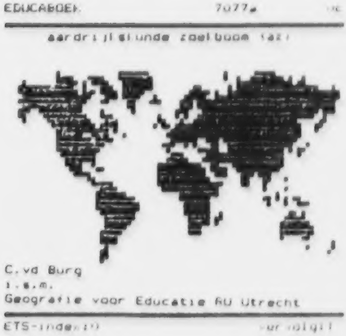
Figures

Fig. 1
Total expenses for Dutch Geography Software distributed by educational publishers, ASCON and individuals.





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C.vd Burg
i.s.m.
Geografie voor Educatie RU Utrecht

ETS-index:0 vervolg:1

Fig. 2

First page of the geographical search tree on Viditel.

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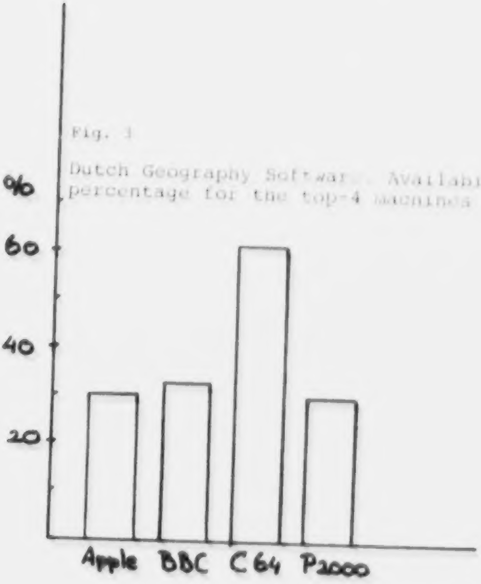

Fig. 1

Dutch Geography Software. Availability in percentage for the top-4 machines (April 86)

Tabel 1 List of Dutch Geography software. Situation April 1986.

title	theme	available for				type
		A	B	C	P (*)	(**)
CACIP	cartography		B			U
Op Reis	map skills				P	D
Krant in Tovedorp	map skills				P	D
Op weg naar het feest	map skills				P	D
Aardrijkskunde Zoekb.	data retrieval	A	B	C	P	R
Molens	location	A	B	C	P	S
Boerderij	farming	A	B	C	P	G
Klimaten	climates	A	B	C	P	Tu
MKT-Klimaten	climates	A		C		Te
Demography BRD	demography	A	B	C	P	U
Honger of Erosie	soil erosion			C		S
Kintara	3 World econ.			C		S
Rivier	map skills		B			G
Dag en Nacht	day and night		B			U
Dorp	settlement loc.		B			S
Diagram	cartography			C		U
Top Ned	topography			C		D
Sluizen	locks				P	S
Het Weer Wereldwijd	climates	A				D
30 Weerstations	climates	A				D
De Toekomst	industrial loc.			C		S
Koperdraad	3 World econ.			C		S
Olievlek	environment. st.			C		S
Polders	water economy			C		S
Geogy	wind directions		B			G
Topografie Nederland	topography			C		G
Topografie Europa	topography			C		G
Topography Wereld	topography			C		G
Geobasics	different drills			C		D
Demografie	demography			C		Tu
Zeilrace	grid references	A				G
Opsporingsspel	grid references	A	B	C	P	G

* A = Apple II, B = BBC model B, C = Commodore 64, P = P2000T

** U = Utility, D = Drill, R = Retrieval, S = Simulation, Tu = Tutorial
Te = Test, G = Game

THE USE OF MICROCOMPUTERS IN THE TEACHING OF SECONDARY SCHOOL GEOGRAPHY IN AUSTRALIA

Colin Davey

Australia

The micro-electronic information technology revolution is spreading rapidly in Australia. Whereas the industrial revolution represented an extension of human muscle the information technology revolution extends eyes, ears, brain and nervous system with prospects of major changes in patterns of living and working. For urban development an information based technology holds prospects of increased dispersal of both activities and interactions (Brotchie, 1984). Changing spatial organisation and societal patterns of living will provide plenty of opportunities for the application of geographical knowledge, skills and values. Geographical education must face the challenge of preparing students for life in a rapidly changing environment.

This demands more than learning about change. It is essential that geographical education be accomplished through the capabilities offered for obtaining, presenting, processing, producing and transmitting information. Telephones, satellites, databases, videodiscs/tapes, plotters, digitisers, modems and printers are some of the technological devices which must be employed in moving beyond the confines of the microcomputer. Geography appears to offer one of the most important means of preparing students for the new forms of socio-spatial interaction.

The fruits (and labours?) of information technology enmesh us in everyday life in Australia. Australians have been urged to foster the ability to learn and handle new situations through an education system which will nurture its most valuable resource - its people (Department of Science and Technology, 1984). The microcomputer must be understood as just one manifestation of the new technology but is, perhaps, central to educational efforts. What has been happening in the last five years in Australian schools? Do schools appear to be in a position to prepare students?

By the end of 1985 Australia had an installed base of more than one million personal computers (Kavanagh, 1985). Education's share of this base is a matter of conjecture but a calculated guess of from three to five per cent is in proportion. Most of these are employed in special computer studies or computer awareness courses in the secondary school. Some are used in specific subject applications such as geography. Why is there such an apparent mismatch between society and educational practice in Australian secondary schools?

The path to a general integration of microcomputers within the geography curriculum is marked by some obstacles both real and perceived. These include the following:

- the lack of acceptable software;
- a lack of teacher education;
- little evidence of the effectiveness of use;
- the technology is costly;
- the technology has not yet matured;
- difficulties of integration within the curriculum;
- a need to change classroom management styles;
- a perception by some that geography is not the province for computers;
- teacher concerns over time, reources, expertise etc.

Not to be ignored as a further obstacle is the federal system which results in eight distinct State and Territory education systems which provide for government schooling for approximately 75% of secondary students. Within each State/Territory the denominational and independent systems catering for the remainder of the secondary students provide further fragmentation of effort. Each State/Territory system determines its own policies and practices with minimal influence from the federal government. At the national level the period 1984-86 has seen the funding of a Computer Education Programme focussed on secondary schools. The sum of $18.7 million has been provided from the Commonwealth Government for the three year period. These funds have been dispersed to the States in proportion to school population and have been applied within the guidelines of the Commonwealth Programme. In practice each State/Territory provides further funding support for computer education and develops its own policy and procedures. Each school has a further degree of autonomy in formulating its own policies and can raise and spend funds through parent organisations. Thus the situation is quite variable from one system to another and there is no clearly national position. Some generalisations can be made, however.

Since 1980, when the microcomputer age dawned for most geography teachers, there has not been a rush to incorporate the new technology. General interest in the use of computers and information technology did, however, accelerate during the period 1983-84 (Anderson, 1984). By the end of 1983 the National Advisory Committee on Computers in Schools reported that the majority of secondary schools in Australia had at least one microcomputer (Commonwealth Schools Commission, 1983). The National Advisory Committee, and other reports, recognised the value of computer assisted learning in "various curriculum areas" (e.g. N.S.W. Department of Education, 1983) and, at the national level, foremost amongst the desired student outcomes is that the information technology should be used for enquiry, analysis, information processing and problem solving within the context of the broader curriculum (Commonwealth Schools Commission, 1983). "Computing" is not seen as another "subject" but provides a tool for imaginative and relevant learning experiences. Such statements have provided opportunities for geography teachers within particular systems.

Some States have supported computing initiatives in schools for longer periods than others. South Australia's Angle Park Computing Centre has provided a service to government and non-government schools in that state and the Northern Territory since 1968. Tasmania established the Elizabeth Computing Centre in 1975 together with a statewide network (TASNET). Western Australia established its Schools Computing Centre in 1977. Other states followed the federal initiatives of 1983 with their computer education centres. Those systems established earliest have been characterised by a greater degree of co-ordination of activity. The remaining States (New South Wales, Queensland and Victoria), those having the largest populations, had no co-ordination prior to 1983-84. School-based approaches dominated in choice of equipment and provision of software.

Hardware

Australia's Telecom commenced its public videotex service, Viatel, during 1985. Viatel is based on British Telecom's Prestel system. A significant feature in a large continent is that connection to the service is through a dedicated packet switching system (Austpac) and is charged at the local call fee from anywhere in Australia. Viatel is only a prospect for geography teachers at this stage of operation while schools await evaluation of suitable modems and software by State education authorities. An interesting electronic writing project - the Australaskan Writing Project - uses Viatel services to exchange written information between certain schools in Australia and schools in the Arctic Circle region of Alaska (Beazley, 1985). To date this has taken the form of an exercise in journalism but extensions are planned to exchange "geographical" information. Viatel is being developed for distance education by the Correspondence Schools and is being used by at least two universities for off-campus studies. For most geography teachers this is an "on the horizon" feature but one which holds enormous possibilities for database access, software dissemination, information exchange and . ...?

The everyday microcomputer application and use revolves around the machines in schools. A range of hardware is found in Australian schools. Precise data are difficult to obtain since not every state publishes results of surveys if they are conducted at all. What follows is a portrayal of some aspects of hardware available to Australian geography teachers. A fairly safe generalisation is that Apple II, BBC Model B and the Microbee (an Australian Z80 micro operating on CP/M) form the bulk of the microcomputers likely to be used by geographers. In non-government secondary schools the BBC micro may well be the dominant make and these are often arranged in networks in dedicated computer rooms. Numbers of micros are increasing quite rapidly making it less likely that hardware access will restrict geography teachers for much longer.

One survey of 415 primary and secondary schools conducted in Queensland during February 1983 revealed that: 297 schools had Apple microcomputers; 9 used BBC micros; 18 used Commodore VIC 20; 26 used Microbee; 64 used Ohio Scientific CIP; 21 used PDP/Spectrum systems; 83 used Tandy equipment; 5 used Sinclair; 21 used the System 80 (a "Tandy compatible") (McBryde, 1983). Many of the schools contained a mixture of makes and models. Given that the applications of these micros were, in order of frequency, Computer Awareness, Computer Mathematics, Social Mathematics, and Accounting, such a mix may be manageable. Geography was identified as a subject application in approximately 14 per cent of those schools which included at least some secondary grades.

A survey of Victorian secondary schools in 1981 also revealed a mix of equipment. Sixty-one per cent of schools reported access to computers. Of these almost three-quarters used Apple, 14 per cent Tandy, 7 per cent Cromemco and 3 per cent System 80. While 19 per cent of schools made at least occasional use of the microcomputer in geography classes only an additional 1 per cent reported frequent use in the geography classroom (Burt, 1982). In Victoria, and elsewhere in Australia, curriculum and computer consultants are of the opinion that there has been a significant increase in the use of microcomputers in geography. This reflects the increasing abilities of teachers, the growth in supply of quality software, and the positive steps being taken by most State/Territory systems to "bring computing out of mathematics and computer studies" and use the micro as a tool across the curriculum.

An indication of the range of microcomputer equipment recommended for schools in different States is contained in Tables 1 and 2. Table 1 shows equipment approved for both primary and secondary schools. In Western Australia the Microbee is used in secondary schools and the BBC in primary schools. The data in Table 2 represents a "best available" summary for secondary schools and it should be noted that the situation is subject to change in a number of States as new contracts are awarded for supply and tenders are called for the supply of equipment. Some States, for example plan to produce software for one machine only though schools are free to purchase any of the recommended microcomputers. To further complicate the situation it should be noted that schools often purchase their own choice of equipment or may be funded independently by suppliers. In South Australia, for example: two schools have IBM PCs through an IBM funded project; two schools have Microbees; two schools are using NEC PC 8201A "lap-helds" as part of a federally funded experiment; a "growing number" of schools are acquiring Apple Macintosh computers; NEC APC III computers are being used increasingly for administration purposes.

Choice of equipment continues to be variable. Local considerations are important also. The Microbee is a notable example of local success. The Australian firm Applied Technology was successful in having the Microbee system chosen for use in Swedish schools in the face of competition from all the well-known international brands thus demonstrating that the local product is able to demonstrate both price and technological parity with imported competitors. IBM has established an Australian assembly plant in Victoria and Sperry is establishing a manufacturing plant in Queensland. Penter (1985,89) has argued that choice of hardware for Australian schools should always include at least one Australian designed and manufactured system as a condition of funding. This has occurred in a partial sense in four States. The Microbee is approved in NSW, Queensland, Victoria and Western Australia and is generally purchased in its 128K "small business" configuration in the last two States. Victoria also lists the Pulsar a locally manufactured 16 bit machine (using an 8088 CPU) which is used for school administration or computer studies courses where its work station networking capacities are utilised.

Numbers of micrcomputers within each secondary school vary both within and between States. Australia-wide an average figure is difficult to obtain since not all States reveal statistics. Some available state figures for numbers of micros per secondary school (1985) are: Australian Capital Territory - 15; Western Australia - 9.25 (with government plans to double this soon); Northern Territory - at least 20; South Australia - at least 11. It must be stressed that these are estimates arrived at by the writer. The only certain claim to be made is that each Australian secondary school has at least two microcomputers and some have as many as one hundred. Western Australia plans to provide one microcomputer for every 40 students. Queensland has embarked upon a Secondary Computer Literacy Project which will augment the existing hardware base through the provision of at least 3,000 Sperry 16 bit, 256K, MS DOS, micros and software packages with the specific aim of increasing computer literacy (i.e. keyboarding, word processing, data bases and spreadsheets). Geography teachers have the opportunity to implement some of the Secondary Computer Literacy Project aims through the integration of the associated software packages within the curriculum though the method of implementation will vary from school to school.

Access to the hardware is a feature likely to influence use by geography teachers. Most states report that the computer room with its bank of machines is the norm. Queensland's Secondary Computer Literacy Project is based upon the provision of computer rooms with numbers of freestanding Sperry PC1 micros (a secondary school with over 1,000 students will receive 30 Sperrys). In South Australia, of 1900 micros some 1500 are arranged in 142 networks. The balance is available to move from room to room. For the geography teacher across the nation the supply of hardware is increasing. Provision of banks of new micros should at least free other hardware for in-class use.

Software

Above all software is the feature mentioned by geography teachers as the greatest area of deficiency. One Australian computer educator has forecast a backlash against the use of computers in education generally unless more is done to address the software needs of schools (Penter, 1985). Geography is no exception. Provision of hardware has been the priority. An accompanying software development programme has been ignored in general though, as some examples to be described below will indicate, there have been some notable changes in the last two years especially in South Australia and Tasmania.

Table 1

Microcomputers Recommended by State Education Departments in 1983

Hardware	ACT	NSW	VIC	QLD	SA	WA	TAS	NT
Apple II/IIe	*	*	*	*	*	*	*	*
Atari		*						*
BBC		*		*	*	*	*	*
Commodore 64								*
Cromemco			*					
IBM PC		*						
Microbee 16/32K		*		*				
Microbee 64K		*				*		
Micromation			*					
Tandy TRS80				*				
Tandy Colour				*				

(Anderson, 1984)

Table 2

Microcomputers Recommended by State Education Departments in 1985-86 (Secondary Schools)

Hardware	ACT	NSW	VIC	QLD	SA	WA	TAS	NT
Apple IIe	*	*	*	*	*		*	*
Apple IIc	*	*						
Apple Macintosh		*	*					*
BBC (Model B)		*	*	*	*		*	*
Commodore 64				*				
IBM JX		*	*					
Microbee		*	*	*		*		
Sperry (PC1 &HT)		*		*				
Tandy 1000		*						
Tandy Colour				*				
Pulsar			*					

(Compiled by Author)

In Australia there has been a reliance upon the commercial provider who is often a distributor of overseas produced software. This writer has produced lists of specifically geography software for both the BBC Model B and the Apple II micro. Of the 114 software items listed for the BBC, 14 are Australian produced. Of the 102 listings for the Apple II, 16 are Australian in origin. The penetration of the BBC micro may be said to be due to the available software as much as to the qualities of the micro itself. Apple, the early starter, has always stressed the range of software for its products. Geography teachers are most likely to be users of these two micros in view of the range of software. Good quality software for the BBC, much originating from Britain's Microelectronics Education Programme, has certainly had the effect of encouraging more geography teachers to become users, and may have made the BBC the most popular micro for geography curriculum software.

Space permits detail on only some of the Australian software.

Early local software for the Apple II range followed the drill and practice mode which characterises so much of the United States educational software. An interesting example is the **AUSTRALIAN GEOGRAPHY TUTOR** which assists students to learn the place geography of Australia. Unlike many packages the **AUSTRALIAN GEOGRAPHY TUTOR** can be used in two modes: 1) as a tutorial program operating in any one of four modes utilising the on screen map of Australia; 2) as an editor which allows the teacher to create special sets of place files for use with particular teaching units across the secondary years. Several place files are included in the package.

Some more recent programs develop concepts and skills through student interaction with the program operation. **RAINFALL RUNOFF** (Riley, 1983) simulates daily runoff from a stream catchment through an application of the Boughton

Model. Information on rainfall, evaporation, capacity of water stores and transfers among these stores is manipulated by the user through alteration of key parameters. Consequences are displayed in the numerical data displayed on screen. It is possible, for example, to illustrate the effects of different catchment land use practices on runoff. Senior geography students can use the simulation to extend concepts related to the water cycle.

A series of programs has been produced to complement a publication - *Moving into Maps* (Butler, *et al*, 1983). While intended for ages 7-11 years (reading age 9 years) the series has been used with lower ability students in the 11-13 years age group. CUNNING RUNNING develops skills of map references and direction as players move a figure around an orienteering course shown on screen. QUICK CARTAGE COMPANY develops skills in planning and map reading through the simulation of a transport company. SCAVENGER HUNT develops the concepts of distance and direction through an "on-screen" scavenger hunt in which players move through the displayed environment to collect objects. Players nominate a distance and direction for each move. SHEEP DOG TRIAL involves a competition between the two players who round up sheep in an area shown on screen. Moves are made by giving a two-figure grid reference. The four programs make good use of colour and represent an interesting integration of published text with software.

ISLE OF WHAT is a computer simulation/role play (for the Apple II) developed by the Soil Conservation Authority of Victoria and their Education Officer, Chris Wootton. The program is intended as an on-going accompaniment to an extended unit on the purposes and procedures of land capability assessment, land management and land use decision making. In conjunction with the program students decide upon a development plan for a hypothetical island and the program evaluates the effects of the student decisions. Target audience is students in Years 10-12. The program is supplied with an extremely comprehensive Teacher's Manual (which includes lesson plans, stencil masters and student guides) and a set of twenty colour slides with details of the environments of the Isle of What.

The commercial product with the widest distribution is the ONE WORLD data base which contains 33 items of socio-economic information on each of 178 countries of the world. The software is available for the Apple, BBC, IBM, Commodore and Microbee microcomputers. Annual updates are available at cost though an "Editor" enables users to keep information up to date. Instruction manual, teacher's notes, maps and student activity sheets accompany the double diskette presentation. A recent review commended the package ".... for its genuine attempt to make a large body of information available to pupils in an exciting and easily accessible form" (Lidstone, 1985). Both New South Wales and the Northern Territory make the product available to schools through the supplies requisition system.

Also from the same source as ONE WORLD, and also intended for use throughout the secondary years, are AUSTRALIA - A PROFILE and HOMETOWN. Each follows the database concept with AUSTRALIA - A PROFILE containing socio-economic, demographic and other data on each of 142 regions of Australia. HOMETOWN is a "framework" provided for the storage of user-collected information about the local region. Subsequent data processing and reporting functions are available.

The database concept pervades much of the more recent Australian software. SETTLEMENT (for the BBC) is a simplified database on countries of the world designed for children of ages 11-12 years. ATLAS DATABASE (also for BBC) is designed for senior secondary students and contains 21 social indicators for 165 countries of the world. A feature of the package is the facility to produce scatter plots and calculate correlations. Each of these packages comes from the Elizabeth Computer Centre in Tasmania - one of Australia's earliest initiatives in schools computing. South Australia's Angle Park Computer Centre (Australia's first) has also developed the database approach in two of its most recent geography packages. WORLD WIDE (for the BBC) contains some two dozen indicators for 165 nations and can perform simple statistical manipulations as well as retrieval functions. LOCAL GOVERNMENT AREA POPULATION (for Apple and BBC) is more specific to South Australia since it contains population census data on 128 local government areas in the State. A variation on the theme is Angle Park's PEOPLE PYRAMIDS (for Apple and BBC). This contains demographic data on 150 countries of the world enabling retrieval, graphing and projections based on birth, death and migration rates. SETTLEMENT, from Tasmania (above), and DIRIGIBLE, from Western Australia, have been described as "....the best school software produced in Australia" (Penter, 1985). DIRIGIBLE is a map reading skills package designed for ages 11-13. Students "fly" a dirigible from place to place taking account of wind speed and direction as well as the usual variables of distance and direction.

Australian software production is small in quantity but does reveal a genuine effort to make the most of the potential of the microcomputer in the more recent examples. Microcomputers are being used as information tools - translators of received data, database managers, data acquisition tools, simulation devices etc. The examples of State-supported software products are few in number and similar in many respects. Yet they represent some prospects of quantity and diversity given some changes in direction on the part of investment in schools computing.

Of great potential for geography teachers is the TASNET system which enables each Tasmanian school to connect to the central bank of Digital VAX mainframe computers of the Elizabeth Computer Centre via one of the 600 terminals, and associated DEC minicomputers, throughout the island state. TASNET supplies

Australian Associated Press news sevice directly to schools (geography "hot off the press") and the associated keyword based information retrieval system enables news items to be accessed for up to one month after first appearance. Schools, and their students, can also use the system to access and interrogate remote databases overseas (e.g. Dialog, The Source). Australia's most recent population census (1981) is stored on TASNET. Special software has been written to enable student access and retrieval via a TASNET terminal and new software is being produced to enable connection of a BBC micro to the VAX systems with subsequent storage of accessed data on the micro's floppy disc. It is planned to produce the system for Apple, Microbee and IBM micros. The census retrieval system will be made available to all Australian schools in the not too distant future. This promises to be a key example of the new information techology and one in which geography teachers should have a prime role to play in the integration of information technology within everyday learning experiences.

The Response of Teachers

"I was shocked at the lack of Computer Assisted Learning in the separate subject enclaves within the schools of N.S.W." (Goodman, 1985).

Australian geography teachers have been slow to utilise the microcomputer as the opening statement from a U.K. exchange geography teacher exclaims. In this respect they appear to be similar to their counterparts in other parts of the world. Many have been disappointed by their early encounters with microcomputers. Much of this disappointment arises from the nature of early educational software and the expectations of teachers that somehow microcomputers would make their life easier and result in a better curriculum. Such an expectation is certainly generated outside the school and, as one Australian information technology educator has noted:

An assumption is often made that as long as there are computers in the school, children must be gaining better and more relevant knowledge.
(Hammond, 1985)

Teachers have become wary of such an assumption. Indeed there are dangers of a backlash of resistance as computers may be seen as more trouble than they are worth (McCluskie, 1985). Herein lies a challenge to all concerned with the provision of a quality education which develops capability and adaptability in young people. Teachers of geography (and other subjects) need to be persons who:

* are aware of the potential of computing;
* know how to operate the hardware;
* know of available software;
* can select and evaluate courseware;
* have classroom organisational skills to make the most effective use of information technology

(Commonwealth Schools Commission, 1983)

These are not obstacles to geography teachers. They represent opportunities.

Some teachers have explored the opportunities. However, little of this exploration has been documented. Horsley (1981) presented the results of some classroom-based research within the social sciences curriculum area. He noted that simple drill and practice program involving recall of capital cities did not provide effective learning since students had limited control and response. Where the graphics capacities of the microcomputer were used to show change in an economic model (i.e. the electronic blackboard mode) students performed at a "significantly higher level" (Horsley, 1981). Both the electronic blackboard mode and software which involved student interaction proved superior to learning through conventional methods of experience. McCauley (1983) has reported experiences using VILLAGE, a simulation that develops the concepts of location, site and situation as students choose the best site for a village around the year 600 A.D. (Payne, Hutchings and Ayre, 1980). The simulation was used with Year 11 students engaged in a unit on settlement patterns and processes. It was found to have: created intense student interest; enabled complex calculations to be performed rapidly; clarified some basic principles of location.

Others have reported informally that student-centred learning styles - both individual and in groups - have proved to be most effective. Individual teachers have reported that simulation software has, in fact, provided the added benefit of introducing both teacher and students to group work since the one microcomputer available necessitated a restructuring of the approach to classroom management and the arrangement of learning. Others have found some software to be particularly effective in the electronic blackboard mode (e.g. demonstration of changes in population size and structure) whereby the micro becomes a dynamic overhead projector. Some have found value in software which permits both student interaction and electronic blackboard modes. Dove(personal communication)describes DEVELOPING CITIES as the software to which "teachers responded more than any other software used in in-service courses". In the electronic blackboard mode the software generated discussion based on the screen events. Student ineraction was also involved through student decision making. Frith (personal communication), a geography teacher developing computer software in South Australia, reports that most teachers use the computer in a student-centred mode where the class is taken to the computer room and all students use the same program at the same time. Teachers using the electronic blackboard mode have been the exception rather than the rule. This demonstrates the variation which occurs as teachers adapt to differing hardware provision (see above on hardware) as well as specific software qualities. Expected developments in both hardware and software should see a move away from whole class student-centred use to truly individual and interactionist modes as students use, for example, databases to explore ideas, solve problems, present reports etc.

Australian teachers have been informed that microcomputers will both influence what is taught and precipitate change. They have been presented with possibilities and methods of using the microcomputer in the geography curriculum (Forer, 1984). In New South Wales the present writer has offered increased educational outcomes and satisfactions derived from geography teaching once the microcomputer is adopted as one of the learning resources. This has been attempted through writing on the educational roles of the micro and software to implement these (Davey, 1983) and through the conduct of in-service courses. An outline of an in-service program is set out below:

GEOGRAPHY AND THE APPLE MICROCOMPUTER

MONDAYS: 4.30 - 7.30 p.m.

AIMS
* to acquaint participants with the Apple microcomputer;
* to introduce methods of using the microcomputer in secondary geography;
* to give participants experience in using a variety of programs.

DAY 1
Introduction to microcomputers
Using the Apple in the teaching of secondary geography
"Hands on" experience with the micro

DAY 2
"Hands on experience"
Integrating software and micros with the curriculum
Evaluating software : criteria and application

DAY 3
Recent developments in hardware
Using the graphics tablet in geography
Using statistical, graphical, filing, reporting and word processing programs

DAY 4 The Apple and Landsat (using APPLEPIPS)
Using an authoring system to create learning modules
Integrating the micro into the geography curriculum:
a plenary seminar

Teacher response to such in-service activity has been positive concerning the actual course experiences but has often been negative when participants have been asked "Will you implement the ideas etc. encountered at this course?" The reasons have been set out in the introduction - perceived and actual obstacles to implementation within the school systems.

Research Needs

The technology of the information society has become available before sound educational philosophy, theory and practice has been worked out (Hammond, 1985). Research has been ignored. Adequate research and evaluation of the microcomputer in the learning environment is an essential basis for the demonstration of effective use. Specifically there is an urgent need for research into both the learning effectiveness of using the microcomputer and the most effective learning styles for the achievement of desired outcomes. These aspects are related to the software design process itself. What makes good software? How should good software be produced? Lessons may lie in already acknowledged quality software such as DEVELOPING CITIES which entails simplicity, attractiveness and flexibility yet leads to student learning through decision making, problem solving and interaction. A concentration on "product-oriented" performance indicators is not the type of research needed. Rather the research should provide illuminative evaluation (Munro, 1977). Observations must be made during the context and process of exposure to the educational innovation.

A fourth area of research is that of teacher education at both the pre-service and in-service stages. The geography teacher remains the key variable in the implementation process and often the learning is of a type that the teacher might not otherwise undertake with students. Appropriate forms of teacher education are a necessary accompaniment of the previously identified research areas. This has been recognised by the Commonwealth Schools Commission (1983). Sinclair, Holmes and Nylander (1985) have described one approach to in-service teacher education which involved a one-month full-time course (funded by IBM) for 4 teachers from each of 8 selected schools. At the conclusion of the course the selected teachers returned to their schools to provide dissemination to colleagues. Follow-up assistance and support will be provied over several years by the associated teacher education staff. This development may offer an appropriate model for geography since the short in-service courses which have received funding represent only a scratching of the surface. Teachers must change classroom style and learning models to make effective use of the micro as a tool for data management, learning and information processing.

The fifth research area is that of innovation diffusion. Too little attention has been given to the means by which new practices and products become established in the curriculum. Implementation of the findings of research must occur if the expenditure is not to be wasted.

A sixth research aspect is within the hardware and technology itself. What technological developments can serve the needs of the geography curriculum? Some areas which suggest themselves are:

* the micro as a data acquisition tool as in remote sensing - weather satellite imagery for example (Moffat, 1983);
* computer-assisted cartography;
* retrieval and exchange systems for information in numerical, text, map and other formats;

- applications and software to enable the use of Australia's VIATEL system;
- remote data collection methods such as weather observations;
- interactive videodisc and videotape.

Research is also needed into the use of applications software (i.e. word processors, databases, spreadsheets etc.) and their applications to data manipulation, dynamic modelling and so on through a content-free vehicle. Business software is more highly developed than educational software and provides an excellent vehicle for thinking with computers and using the computer as a tool to do what the learner wants (Ogborn, 1985). There are increasing numbers of teachers using applications software as personal tools. Their potential for geographical education remains to be explored.

The Future

Microcomputers began in Australian education as an end in themselves. Ability with the computer (computer literacy) was seen as the method of entry into a golden future with associated economic and lifestyle benefits for the individual. Students appeared to be destined to become tools of computers and the manufacturers that produced them. Fortunately most, if not all, of the educational decision-makers have recognised the need to be vigilant in avoiding a movement towards a redirection which may not be desirable in the long run (e.g. Matheson, 1985). Information technology is becoming accepted as a vehicle for enrichment of living alongside other forms of expression, communication and interaction. Some indications of educational enrichment for Australian geography teachers have been presented in the discussion of research needs. These arise from a "coming-of-age" within education. Geography is particularly well placed to benefit from this maturing attitude.

Direction has been given by the National Advisory Committee on Computers in Schools which stresses the use of computers in teaching across the curriculum. Stage Two of the Commonwealth Computer Education Program (to commence in 1987) should see the development of software curriculum packages for specific subjects and the establishment of a recommended National Software Co-ordination Unit as part of the Commonwealth Schools Commission Schools Development Programme. The Unit will "....evaluate educational software, disseminate information and assess procedures for the economical acquisition of quality educational software on a national basis" (Commonwealth Schools Commission, 1986). This promises some needed augmentation and co-ordination of individual State/Territory efforts. During 1986 the Curriculum Development Council will present the results of its software needs study as key input for the new Unit. Some of the disadvantages of the dispersal of effort may be reduced through the establishment and operation of the Software Co-ordination Unit though there is still some uncertainty about the degree of support for secondary education given that Stage Two of the Commonwealth Computer Education Program will emphasise computers in primary schools. Geographers wait in hope. Perhaps Australia might achieve some of the benefits which have accrued to geographical education in Britain through the operation of the Microelectronics Education Programme (MEP)?

It is important that geography teachers respond as a body of organised professionals (through State and National geography teachers' associations) in order to obtain support. Secondary school geography teachers must utilise the opportunity to participate in an era of increased relevance made possible by developing information technology. We are at the dawning of an important era for the geography curriculum.

Acknowledgements

I am especially grateful for the assistance provided by: Mike Dove (Vic.), David Frith (S.A.), Shirley Grosvenor (Tas.), Greg Hayden (Q'ld), Joe Kalajzich (W.A.), Phil Lantry (N.S.W.), Paul O'Neill (Q'ld), Linda Wilkinson (Q'ld), Peter Wilson (Q'ld), and Chris Wootton (Vic.) for the time and effort spent in showing, telling, and/or writing to me about microcomputers and secondary school geography.

Thank you also to David Frith (S.A.), Vic Jenetski (N.T.), Roger McShane (Tas.), Steve Murray (Curriculum Development Centre, Canberra), Jim Sulley (W.A.), Graham Thomas (Vic.), Michael Thompson (A.C.T.) and an anonymous lady (Q'ld) (my apologies) who were all most helpful in answering impromptu telephone requests for information about the respective education systems.

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Computer Software

APPLEPIPS (Apple Personal Image Processing System) - if access available to Landsat image data on diskette then data for a 90 square km ground area can be processed. The Telesys Group, 5455 Wingbourne Court, Columbia, Massachusetts 21045, U.S.A. Cost : approx. $500.00 (U.S.)

ATLAS DATA BASE, Elizabeth Computer Centre, Cnr Warwick and Murray Streets, Hobart, Tasmania 7000, Australia. (BBC)

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AUSTRALIAN GEOGRAPHY TUTOR, Lothlorien Software, P.O.Box 1033, Sydney, NSW, 2001, Australia (Apple II)

CUNNING RUNNING, Jacaranda Wiley (1984), G.P.O.Box 859, Brisbane, QLD. 4001, Australia. Cost: $45.00 (Aust.). (Apple II, BBC, Commodore)

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ISLE OF WHAT, Soil Conservation Authority of Victoria, 378 Cotham Road, Kew, VIC 3101, Australia. Cost: $50.00 (Aust). (Apple II)

LOCAL GOVERNMENT AREA POPULATION, Angle Park Computer Centre, Cowan Street, Angle Park, S.A. 5010, Australia. Cost: Approx. $60.00 (Aust) (Apple II, BBC).

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COMPUTER BASED EDUCATION IN GEOGRAPHY IN NEW ZEALAND

Pip Forer

New Zealand

Summary of Trends 1980-85

New Zealand had virtually no involvement with traditional, mainframe-based Computer Assisted Learning. However during the early 1980s its high schools became very active in the purchase of micrcomputer hardware and geography teachers were amongst the most responsive of the non-maths teachers in their initial responses to the new technology (Jaspers, 1984). There followed a rapid experimentation with various forms of software, and an inevitable period of sober reassessment. This was mainly fuelled by a lack of appropriate programs and a growing recognition of the problems of implementing software into specific classroom situations. In particular many overseas programs that sought to break new ground as teaching tools were found to be too specific or unsuited for use in a New Zealand context. Current developments are more realistically founded, but remain hampered by poor central support for integrated implementation within New Zealand. Roughly 25% of schools use computers in their geography teaching, the 5th highest proportion for any non-maths/computing subject.

Some background is necessary to appreciate the specifics of the development of computer use in geographic education in New Zealand. A significant factor is scale. New Zealand's school system is small (the total population is just under 3 million people) but has a reasonably high and rising level of computer ownership in the high school sector (an average of 7 machines per high school in June 1984, estimated around 10 per school in 1985). The system evolved as highly centralised with national curricula, resource provisions and accreditation systems being the norm. A recent trend however has been greater local autonomy within this national framework.

At the grass roots level geography is typified by a highly professional, innovative and motivated body of teachers and there is a long-standing tradition of local community support to schools via parent fund-raising. At the institutional level the previous administration accorded education a relatively low funding priority. This has improved under the new minister, although support for computer education is still minimal, including central resources allocated to foster computer applications.

The situation of a motivated profession and public and an unresponsive administration has resulted in a heavily grass-roots approach to school computing typified by the Regional Computer Education Societies. These bodies have catered for general computer awareness and some specific applications in subject areas. In geography their efforts have been considerably enhanced by activities within the New Zealand Geographic Society, most recently through the high-school oriented Geography Resource Centre at Christchurch College of Education and the editorial policies of the New Zealand Journal of Geography.

Computer applications exist only in a curricular setting. Geography in New Zealand appears as an entity separate from social studies during the last three high school years, two of which are optional. In the younger classes it is strongly represented within the social studies curriculum.

Geography is a significant examination subject being between the 4th and 7th most frequently taken subject in 1979 (Johnston, 1982). Geography across this age group has just entered a transition period when a new, more flexible curriculum is being introduced. This is built up of a common core, shared by pupils at all schools, and a significant, local optional component. Given that the common core also offers considerable scope in choice of the actual topics chosen to illustrate particular concepts, there is a growing diversity in the material that students from different schools may cover. There is also great potential for individual innovation to occur. Full details of the new syllabus can be found in Young (1978, 1981). The actual syllabus has a limited overt response to applications of new technology. However it is characterised by flexibility within which there is certainly room for adopting new ideas and approaches.

The state of flux increased in 1985 when the new government abolished the long-standing University Entrance examination taken by many advanced students for certification purposes. It has been replaced with a new qualification, the Sixth Form Certificate. One response to this has been to seek to move away from traditional examination and discipline oriented approaches. One trial project at Freyberg High School in Palmerstone North seeks to combine geography with computer applications, English literature and outdoor recreation in an integrated certificate course. This experimental unit is to be based around intensive field work in national parks and similar areas, which will provide the context for computer analysis, report writing and links to the writings of New Zealand authors. The initiative for this project stems from the Department of Education at Massey University.

Computers in geographic education in New Zealand are at an interesting stage. Initial response has been positive. However the combination of a small education system, diverse machine types and a locally flexible curriculum pose particular challenges and offer particular possibilities for the design and implementation of educational software.

Hardware

The New Zealand market is open to hardware from a variety of sources: in particular America, Britain and Japan. Machines tend to appear on the market quite quickly after overseas release, although hardware is expensive (perhaps 150-200% of European or North American retail prices). New Zealand schools began to invest heavily in computer hardware from 1981, obtaining money predominantly from parent fund raising activities by individual schools. Because commercial motivation to support local manufacturers is less, and balance of payments implications negative, earmarked government hardware funding has been limited.

Prior to 1980 only a very few schools had computers and they were generally Digital Equipment minicomputers. Apple distributors made an agressive sales pitch in 1981 which saw almost all schools purchasing single Apple IIs as trial units. This has had long-standing ramifications for both the pattern of follow-on purchasing and the provision of training. In the same year an innovative local machine, the Poly, appeared offering superior graphics and local networking. Unfortunately it required purchase as a network of several machines when most schools were seeking to test the waters with single units. This placed the Poly at a price beyond most school budgets and the Poly remains a minority machine in schools in spite of overseas sales for industrial and military training.

In 1982 speculation mounted on whether a single machine would be officially adopted as standard. Lobbying eventually led the Department of Education to issue a recommendation to schools. This unfortunate document recommended not less than five machine types as suitable for purchase by schools, thereby ensuring significant and long-standing problems in developing coordinated educational software of any sort (Smythe, 1984).

Of the five recommended machines only two have since made significant inroads into schools : the Apple II and BBC B, the BBC being installed almost universally on networks. These have been joined in smaller numbers by cheaper alternatives: especially the Microbee (an Australian machine) and the Commodore 64. There is now also some evidence of movement into MS-DOS machines.

The situation in 1983 can be discovered in Forer (1983). The situation as of November 1984 was that Apple held 56% of the market, BBC 23%, Commodore 11% and the rest 10%. BBC's and Commodore's shares have been growing recently.

In general the early keenness of many geography teachers has ensured access to computing. However, pressure on hardware is mounting. While geography established itself early as a legitimate user, initiatives similar to the discovery of the word-processor by teachers of English in 1985 will stop access to machines being a matter for complacency. In some schools computing is still viewed as primarily a maths resource. These anachronistic fiefdoms are slowly dwindling however, especially as subject machines located in subject areas become more commonplace.

A few schools are retaining their 8 bit systems and augmenting them with 16 bit ones. Most though have just upgraded their existing 8 bit models and added more.

The hardware situation over the next 2-3 years depends on two prime factors. One is a source of re-equipment and expansion funding, given that the parental enthusiasm for fund raising may find new directions. The other is the attitude of teachers, who may feel that retooling to a new, more powerful machine type may not be worthwhile. Although there is great potential in the new generation of WIMPs machines such as the Macintosh and Amiga, this suggests that their introduction may be far slower than systems enthusiasts believe.

Software

Overview

New Zealand geographers have shown particular preference for two sorts of software: generic software that involves a data resource (spreadsheets and data-bases) and simulation software, especially if it can be linked to a real-world data-gathering exercise (see Thompson, 1985). The old resource-management game HMRABI was perhaps the first unit used, soon followed by the HUNTINGTON packages from Dartmouth College. Of these LIMITS and POLUT were most used. POLUT simulates pollution levels in a variety of bodies of water under various conditions and proved to be by far the most popular due to the ease with which it could be linked into both the curriculum and local environment (Forer, 1983).

Various other overseas units have been adopted. In general it is fair to report that, apart from generic software, some disappointment has been experienced in the quality and usefulness of much of what has appeared and been bought sight-unseen. This is perhaps best typified by Longman's SAILING GAME where a round-the-world voyager finds not only New Zealand but half the Pacific Ocean missing from the program's screen map. Some more recent releases have enjoyed greater appreciation. (Green, 1985). BBC users have found more in common with their UK counterparts than Apple users have with US initiatives and have developed a broader software base of specifically geographic software.

Most of this software is imported or authored privately. There are several problems in distribution which are exacerbated by the low central support for courseware development (Forer, 1985). Resources available in 1983 to handle the support and evaluation needs of the entire education system with 5 officially supported machine brands amounted to two people! Full-time support personnel were recently increased to seven.

Clearly the many benefits of co-ordinated project development have little chance of success within this environment. The main positive responses have been through the New Zealand Geographical Society. It's teaching journal, the New Zealand Journal of Geography, now runs a review and comments section on geography software that helps share commentary on what is available. The Society also operates the Geography Resource Centre, which has recently moved into software distribution with the aptly-named BP oil-spill simulation SLICK!

Local software is augmented by material from across the Tasman Sea. Three Australian states operate a software consortium, TASAWA, and some work has been done to use some of their material. In particular Wessoft's RESOURCES unit and a data base, the FIRST FLEET have attracted interest. The FIRST FLEET is a data base of first settlers to Australia. Work at Linwood High focussed on a New Zealand equivalent, the FIRST FOUR SHIPS.

With generic software teachers are increasingly developing local applications involving the computer media (data bases and spreadsheets), visual imagery on slides and local fieldwork. An outstanding early example of this is the work of Green at Kaikorai Valley High School (Green, 1983). Data handling applications may expand as New Zealand now has several videotext facilities and has just installed a packet switching network. Both public data bases and software distribution may develop if some central initiative such as the UK CET's Education Umbrella on Prestel were to be implemented.

The early development of New Zealand authored courseware, including the strong position of geography in the Poly development initiative, has been detailed elsewhere (Forer, 1983). What follows is a list of the main software units actively used or developed by geographers within New Zealand.

Simulations

Simulations have enjoyed some popularity amongst geography teachers, although no one simulation has become universally supported. A strong theme is that of resource allocation. Resource allocation simulations in use within social studies and geography include : HMRABI, KINGDOM and PEASANT. PEASANT is based on a South East Asian village environment and enjoys particular use in area studies and universities. GOLD-DUST ISLAND is another (Australian) simulation, this time involving trading and construction tasks, which has attracted devotees with earlier classes. This theme has been extended by NOMAD from the BBC Introduction to Geography series.

This series (and to a lesser degree its successor) have found a positive response. WILDERNESS too has attracted interest with its simulation of a map-reading problem. Certainly other units in this area, such as the mapping units from Cambridge University Press and Longmans, have yet to make a similar impact.

Wider simulations touch other themes. New Zealand's agricultural background is picked up by a farming game simulation THE NEW ZEALAND CROPPING GAME, a development of the British Farm Game developed by David Walker and Deryn Watson. This is aimed at fifth formers (15-16 years old) and has been designed at Christchurch College of Education (Macauley and Eagle 1985). HUSTINGS 84 takes up a political theme and is a simulation of the 1984 general election where the user can input various inter-party shifts and run a new election (Tate, 1985 is a review of this unit). This appears most useful within social studies below Form 5.

Urban simulations get represented by the early New Zealand City Unit, a set of four urban simulations designed more to test machine capability rather than be pedagogically ideal. A shopping game known as RETAIL from this became widely distributed. In it two players play a shop-location game to try and attract the maximum amount of shoppers for their stores. One of the most recent simulation developments stems from this project : RETAILNET. This is a multi-player, networked version in which each player independently locates stores from their own machine on the network and the network coordinates the overall results of the game through several rounds. The game is then available for recall and analysis by the players. RETAIL was originally found useful in introducing notions of spatial competition and the results of competitive versus cooperative strategies. RETAILNET is an enhanced environment for this and hopefully will be released to schools shortly.

Authoring Languages and CAI units

Authoring languages have not found wide favour. The PLATO series for the Apple II has generally been viewed as over-priced and educationally barren. However, some early work on Super-Pilot came out of the Otago University Department of Education under the direction of Larry Nelsom, including a teaching simulation on the early gold rushes that has geographic value. Local software has been largely for the BBC computer. Some use has been made of KIWIQUIZ, a map-based question and answer unit suitable for a limited amount of introductory drill work on New Zealand locations (largely been at 3rd and 4th form level). John Collett at the French Department of Waikato University has produced the most significant product, a tutorial language known as PROFORMA. This works well on a BBC, both on disk and network, and has formed the basis of several tutorial units from that University (Chalmers and Collett, forthcoming). Work is now under way on Flood Hazard units using PROFORMA, a topic which is a significant component of a Natural Hazards topic required by the new syllabus (Barbour and Ericksen forthcoming).

A further project at Waikato is the development of a prototype interactive video system based on the BBC computer. This uses the CAVII interface, a control and editing interface developed at Christchurch Polytechnic, to work with videotape. At present this system, code named Arete, is in a prototype stage, although an initial unit on volcanism has had some field trials. However the development design of Bob Barbour is for a mixed-media system utilising flexible inputs and outputs. There are further comments on this system in the 'Future' section.

Data in Context Programs

Using real-world data in simulations, project work and regional studies has been a specific strength within New Zealand. There are several examples of these which use either purpose-built programs to work with the user or general-purpose packages. In terms of terrain modelling SUPER SURFACE is a surface-plotting package that lets the user input spot heights and create contours, shaded views and slope maps of an area. It has been used in some local studies units.

WORLD IN VIEW, trialled at fifth form and above, comes from Otago's Eaglesoft and is more mainstream. It is a series of programs that offers to the user traditional mapping options with built-in data base management capabilities : proportional circles and flow patterns with volume-dependent scaling. In both cases the user can build their own local study data base (the local paper's distribution for instance). With circle data a quiz-creation option is available and has proved popular. The suite also features a world map and a chance to fly between different locations, using great circle routes plotted on the map and with estimates of flying time.

REGIONAL TRENDS is a suite that allows data manipulation in a strongly constrained format using two options. One graphs selected regional unemployment statistics and overlays the results for two chosen areas for a specified time span to allow comparison. Summary statistics are given and one area can be regressed against the other if wished. The second part is a more flexible data base and mapping package that lets the user investigate the background economic and social structure of the area.

The response of the teachers

Introductory in-service training became available through University Departments of Extension Studies and through the New Zealand Geographical Society from 1979. These were augmented from 1981 by school-wide courses often utilising the one-day school-based refresher facility known as 'teacher only days' and by specific in-service or polytechnic training courses.

Given that the level of available training is still low and time allowances for computer support within the school not well developed, it is not surprising that adoption of computing applications has not fully penetrated the teaching body. At present there may even be some decline in use by some of the early innovators who have found continued use without sufficient support to be too demanding. On the other hand the process of computer use is contagious and new users are following the lead of fellow geographers or colleagues in other disciplines. A solid pragmatism rather than the over-enthusiastic adoption so well described by Self (1984) prevails, and this is to the good.

Support from tertiary education has slowly grown. Two university geography departments in particular have attempted to integrate computing applications into their teaching as teaching, rather than research devices from an early stage. These are at the Universities of Canterbury and Waikato. The former have perhaps achieved a greater local use while the latter offers a very valuable computer education paper jointly with their Education Department.

Support in Colleges of Education has been slower to emerge, partly because of severe cutbacks in staffing at what was a crucial period in early computer adoption and partly due to a reticence to commit themselves to specific machines and approaches pending positive government guidance. Support for educational computing is now much stronger, although support for geographic applications in particular instances depends on the orientation of the individual department's concerned.

Research Needs

The main areas in which research is needed are those common to computer assisted learning in general : establishment of the effectiveness of particular strategies and the costs of their implementation. Geography is also not atypical in that much of our assessment work requires the ongoing development and evaluation of software on a reciprocating basis (Lewis, 1985). The main distinctions with geography has been the contexts, with our stronger emphasis on field work, graphicacy and topical data.

For all research a prime need is funding support. In New Zealand this has posed special problems. For some time now the Department of Education has operated support grants for either research or curriculum development. Computing support from these has not been great and is complicated by the fact that neither fund sees a typical computer project as falling solely within its own area of support.

In 1985 special grants approximately to $NZ 500,000 were made for evaluative studies in computer education. The opportunity for research given by this looks likely to be whittled away as grants will go predominantly for hardware purchase and many of the studies will amount to little more than hands-on training and exploration. The only geographic support given in this exercise is a minor grant to Greymouth High School to work with satellite reception of weather data. It is unrealistic to think that further substantial research funding is likely to appear before 1987.

Areas in which research could usefully be channelled are numerous. Evaluation of the impact of various approaches is internationally still relatively immature and is constantly complicated by new developments which leave the research investigating last year's problems, or at least this year's problems in last year's technical context. New Zealand research in computer impacts in geographic education is very limited.

In this paper suggestions for geographic education research are restricted to three items. One is the evaluation of the costs and benefits of data-centred facilities such as spreadsheets, data-bases and mapping packages. Such an evaluation should not only compare how much the user benefits from use of these facilities compared to traditional ways of making information available but also the costs in terms of teacher training time to use a particular package. With rapid changes in both technology and software, new options appear for the educator daily and in keeping abreast of these and learning new tools the user interface can be crucial. The WIMPs interface pioneered by the Apple Macintosh seems to combine power and ease of use with easy learning curves for new users. This is a graphics-oriented interface with particular benefits for a graphics-oriented discipline like geography, and arguably for educational computing in general. It deserves further investigation on its specific impact on educational computing in geography.

A second component for research is the specific graphics display needs of geographic education. The New Zealand system operates a variety of graphics standards which offer different capabilities for the user. New standards are emerging all the time, with obvious cost/performance trade-offs. Are there clear guidelines on what is possible on different systems and what are bottom-line performance standards for particular mapping applications?

A final need is to assess the possible uses for video and video-imagery. As the comments in the 'Future' section indicate this area has attracted considerable attention within New Zealand and is viewed as a significant growth area. However research into the use of this medium currently also means development of software in this area, a development with currently very little budget support.

The Future

Computer assisted geographic education in New Zealand is faced by similar problems to those faced elsewhere. Perhaps one aspect which is more accentuated however is that of scale. A small system, supporting multiple machine types and with inadequate central support makes development difficult. The problems of production and dissemination of courseware especially tailored to New Zealand needs are considerable (Forer, 1984).

There are however signs of activity in certain areas. Enthusiasm in university departments continues to generate new software, much of which can be tailored to purposes in the secondary sector. Some local software houses and small producers are able to provide quantities of useful material. Perhaps most significantly an increasing number of high-level authoring languages and development systems are becoming available. These are opening doors to more and more custom-built applications that employ the computer as a medium for analysis in a flexible and teacher-controlled manner.

It seems likely that much courseware development will follow a path of creating locally-based informational units using generic programs such as data bases and spreadsheets. The arrival of friendly integrated packages (word-processors, spreadsheets and graphics) and school machines with enough RAM to support them will mark a watershed in this area. This has started, but with inadequate user friendliness, with the availability of Appleworks on the Apple II series. The specifically New Zealand or geographical contribution may be in the use of cheap mapping packages as part of the integrated package.

The inertia of teachers in wishing to remain with known hardware suggests to me that new machine types may take longer to become dominant in schools in spite, in some cases, of their clear superiority. This lag will also relate to software availability, which for good educational software is often a 2-3 year gap. One might expect the traditional 16-bit machines (IBM-PC, JX) to achieve limited market use. The logical step now is to to a WIMPs based user interface with a common user interface for all application, but realistically we might expect more to be operating within existing hardware constraints. This has distinct implications for what we can usefully attempt and display.

It may be that two related developments have far more impact than the processing hardware in use : networking and video-disc. Networking will allow far greater common use of data bases useful in general geographical work, especially as schools network to hard discs where significant common resources can be kept for informal access. The network will also open the way for new forms of interactive software where the dominant form of interaction will be user-to-user rather than user-to-machine oriented.

Multi-player geographic simulations may well be just one example of this.

Video discs in their turn offer enormous opportunities for display and recall of that important geographic resource, visual imagery of a landscape or process. Using such imagery demands an appreciation of place and the provision of local imagery for local needs. In the next five years this will start to emerge. Of the projects currently under development four relate to this possibility. One is the Arete system being attempted by Bob Barbour at the University of Waikato (Barbour, forthcoming). This is a multi-media enquiry system aimed at producing an exploratory learning environment based on holistic concepts of education. The ideas may be similar to those underlying the Boxer project in the United States, but the scale is far more modest.

Another project is the low cost Image Atlas being developed at the University of Canterbury which seeks to link census data and video imagery to give a utility with far greater ability to communicate geographic patterns and realities. The third is the proposal to develop a national 'snapshot' disc along the lines of the Domesday Project in England. Like the Image Atlas (of which it could form an extension) this proposal would seek to marry conventional mapped data with imagery, all being accessed through a user interface employing a mouse-driven pointer and a map base of the areas involved. Finally a proposal has been mooted to work on a way-finding training disc aimed at imparting map-reading skills (Forer and Hockey, 1983).

An area of software that may exert growing influence may be the development of expert systems, intelligent tutors and similar applications of artificial intelligence software. While scepticism is justified given the wilder claims in this area, the potential impacts are enormous, both in managing large data/visual resources and in resurrecting some of the early hopes voiced for Computer Assisted Instruction. However, hardware able to cope with this seems unlikely to be installed within two or three years.

The future will hopefully show increasing ease of use in software and increasing integration of software into the curriculum until it becomes, as Liddy Neville has put it, 'part of the furniture'. Because of the greater problems of development of traditional Computer Assisted Instructional material the tailored simulation or tutorial may lower its profile in the next five years, particularly in New Zealand where the market for specific units is very small. We may eventually see a resurgence of such material in a subtler guise as work in natural language interfaces and artificial intelligence makes the construction of custom-built and responsive units in this area more feasible.

New Zealand will remain a cautious user of externally authored software. The attractions of generic software for producing tailored local applications will continue to make this form of application more than normally popular. Any unique new developments are most likely to occur in small projects, taking overseas developments in different software and hardware areas and recombining them in new and useful ways.

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Software Units

The list which follows covers the main items cited in the text, where their general function is outlined. Contact addresses for information or software are given, along with the approximate costs at the time of writing.

FIRST FLEET was developed for the Apple II at the Queen Elizabeth Computing Centre of the Tasmanian State Education Department. It is distributed under licence to various Australasian education systems. The FIRST FOUR SHIPS will use its data management programs with a New Zealand data base. Used under inter-government licence.

GOLD DUST ISLAND is a simulation from Jacaranda Software Pty., Melbourne, Australia, $75.00

HMRABI is a minimal BASIC program published in 101 BASIC GAMES (1978) from Digital Equipment Corporation, Maynard, Massachussetts

HUSTINGS 84, REGIONAL TRENDS, KIWIQUIZ and STATSMAP are available from Barson Computers, 1 Ngaire Avenue, Epsom, Auckland, New Zealand priced between $50,00 and $85.00

KINGDOM is a demonstration program on the BBC computer Welcome disk

LIMITS and POLUT are in minimal BASIC and come from the Huntington 2 suite of programs produced by Dartmouth College and distributed through Digital Equipment Corporation, Maynard, Massachussetts, $10.00

NEW ZEALAND CROPPING GAME is being developed and trialled from Christchurch Teachers' College, Dovedale Avenue, Christchurch by John Macaulay and Barry Eagle

NOMAD and WILDERNESS come from the British Broadcasting Corporation's disc 'Introduction to Geography' $75.00

PEASANT is authored by Dr. D. C. Johnston of the University of Canterbury Department of Geography, Christchurch, New Zealand. It is available for the Apple II and BBC Microcomputers, $15.00 on exchange disc basis

RESOURCES was authored by WESSOFT, the software development publishing arm of the Western Australian State Education Department, $45.00

RETAILNET was implemented by Gregg Ewing and Pip Forer at the University of Canterbury Department of Geography, Christchurch, New Zealand for the BBC computer on Econet. Beta test versions are available for $35.00 on a disc exchange basis

SLICK! was produced in the United Kingdom by the Educational Division of British Petroleum. It is available for the BBC and other popular micros. $15.00

SUPERSURFACE was implemented by Jenny Penman at the University of Canterbury Department of Geography, Christchurch, New Zealand. It is available for the BBC on exchange disc basis for $15.00

THE CLIMATE PROGRAM is a series of Appleworks files developed at the Department of Geography, University of Otago, Dunedin, New Zealand by Dave Richardson, a Visiting Teaching Fellow. These are likely to be available through the Geography Resource Centre, Christchurch Teachers' College, Dovedale Avenue, Christchurch at a moderate handling charge

WORLD IN VIEW is published by Eaglesoft, Dunedin. Contact D. Green, Kaikorai Valley High School, Dunedin for particulars of commercial release date.

CAL AND GEOGRAPHY IN SCOTLAND

Dick Jennings

Scotland

Recent Developments in the Geography Classroom

Scotland provides an excellent subject for study because it is a relatively small, self contained system of approximately 400 secondary schools. Partly because of its history and partly because of its size, it is a far more centralised system than England.

The CAL strategies coming to fruition or initiated during the 1980's in geography in Scotland might be categorised as follows:

1. Frontal assault
2. Guerilla tactics
3. Mass conscription
4. The Commando Tactic
5. Independent Operations

All five have their advantages and drawbacks and each will be examined in turn.

Frontal assault strategy is represented by two major projects financed by the Scottish Education Department (S.E.D.) and directed by the author and N.M. Smart (Head of Computer Studies, Aberdeen College of Education).

The two projects ran end on in theory, in practice they overlapped and still overlap. The first was "Geography and the Computer in School Geography: AB6", followed by "Computer Programs in Geography (later Social Subjects): H134/1" 1977-84.

They could be termed frontal assault because they attempted to attack the problems of CAL in geography in a comprehensive manner. Finance from S.E.D. was sufficient to employ staff (programmers and an archivist) and to pilot the material produced in up to a dozen schools throughout Scotland. The bulk of the work was to be carried on by the project directors and their staff at Aberdeen College of Education.

The original objectives, if they had been achieved, could have led to a decisive breakthrough. This would have given the Scottish geography teachers a range of programs and full supporting material to tackle:-

1. All major quantitative and statistical techniques specified in the newly introduced geography 'O' and 'H' grade syllabuses.[1]

2. Large data files which cover all specified areas in the new 'H' grade syllabus. These files to be accompanied by quite sophisticated file creation, editing, interrogation and analysis programs.

The reasons for this approach were:

1. The newly introduced geography syllabus, that was widely welcomed, specified quantitative and analytical techniques that were often awkward to handle by manual means or even by calculator.[2]

2. The new syllabus shifted the balance strongly in the direction of resource based topics and the examination paper reflected this. Thus, teachers and pupils now required data to work with rather than prose description.

3. Information, and especially data, was not readily available for a number of the areas specified in the new 'H' grade syllabus. Centrally compiled data files drawn from census data and national

year books could meet this need and provide data that it would be almost impossible for teachers or pupils to collect. e.g. Brazilian census data.

data

4. Using the computer meant that adequate/sets could be used with the techniques, and pupils could, for the first time, explore a variety of possible solutions to a problem.

5. There was virtually no software available from any source at the time the projects started.

In the light of the above points one big push seemed the answer which could be followed by a topping up process of additional programs and an updating and extending of data files.

To look at the reverse side of the coin, the conditions that worked against the success of this strategy were:-

1. A pre-condition was a technology based round a single model of computer. The advent of the microcomputer in Scottish schools, from around 1977 onwards, undermined the strategy as no one micro was sufficiently dominant.

2. To bring programs up to a standard where they were sufficiently robust to be released even to regional mainframes was far more time-consuming than originally appreciated.

3. The resources required for the massive assault originally proposed were underestimated. In reality it would have required a full-time project team with three to four programmers and field personnel to work with schools.

The outcomes from the two projects, as a result of the mismatch between the vision and the reality were as follows:

1. *AB6 was reduced from an original scheme for an initial 12-15 to a suite of five programs with full documentation. There were considerable[3] delays whilst micro versions were written for a number of machines. Most were never published, only Apple II and BBC versions are available, the latter in a number of forms, to cater for varying disc densities and networks, as well as stand alone micros.*
2. *The micro caused problems for project H134/1 (data files). The limited memory capacity of the micros has made the original concept almost impossible to achieve. The hope is to achieve a BBC version, involving use of a second processor, later this year, developed from extensive work done on the Apple II.*

Despite the time lag the data handling suite of programs (Fig. 1) compare well with other similar programs available in education. Sixteen bit technology and the machine readable data files, now becoming available, encourage the directors to put in the final spurt.

For any group contemplating the frontal assault tactic there would seem to be the following pre-conditions.

1. *A large adequately resourced team, in terms of both money and time.*
2. *Continuity of programmers preferably with some educational or appropriate subject background.*
3. *Sufficiently stable or flexible technology to ensure that the programs, when finally published, are appropriate for the machine in use.*

4. The ability to clearly identify topics for which it is worth producing software. Much software is far too specific within particular topics to really justify its purchase with school departments' small budgets. The frontal assault technique must concentrate on open ended programs of use across a wide spectrum of the subject.

The second CAL strategy might be termed guerilla tactics. This is basically the opposite of a frontal assault. The guerilla tactic is one of infiltration, the setting up of small cells to work semi-independently, largely on their own initiative. For this some intensive initial training is required with the promise of continuing, but intermittent,and possibly distant, support.

The genesis of this strategy was a National In-service course in September 1983, "Microelectronics and the Social Subjects"[4] which the author and N.M. Smart co-directed. During course planning the focus was on the problem of bringing subject teachers into a meaningful dialogue with professional programmers. The problem, it seemed to us, was that too few teachers knew how to specify a program or had the necessary knowledge to discuss their requirements in sufficient detail with programmers. That teachers in geography should themselves become programmers, as some seemed to advocate, is totally unrealistic.

The technique of total immersion was adopted to produce a cadre of teachers that could have, at least, the basics of program specification. There were three geography teams, each with a professional programmer, and there was a subject topic outlined very sketchily, namely "The Demographic Transition Model".

The teams were told to design and specify a program in as much detail as they could, in consultation with their programmer. Time was scheduled each day of the one week course for team meetings and, apart from that, it was

Fig. 1

ACEFILE : FILE PROCESS

DESCRIP	*- Variable profile:*	*COUNT* *MIN* *MAX* *RANGE* *TOTAL* *MEAN* *MEDIAN* *MODE* *STD DEV*
CLASS	*- Classification:*	*Log frequency* *Andrews method* *Hierarchical Grouping* *Frequency table* *Histogram* *Bar chart* *Pie chart* *Time chart* *Cross Tabulation*
CORL	*- Correlation:*	*Scatter diagram* *PPM* *Linear Regression* *Best Fit* *Rank scatter diagrams* *SPR* *Chi square*
MAP *(to be developed)*	*- Mapping:*	*Choropleth mapping*

An outline of the contents of the ACEFILE PROGRAM: FILEPROCESS.

Other programs in the suite deal with preparing and editing data files.

up to them.

The results exceeded even our most optimistic forecasts, since by the Friday afternoon there were three versions of the program specified, written and actually running.

Although very gratifying, this exercise was only a means to an end, that of producing teacher/program specifiers. Two such groups formed from course members as a direct result of the course:-

1. Scottish Computer Development Group.
2. Moray Firth Software Group.

Both groups are still going strong in 1986. The Scottish Computer Development Group have become commercial and have a list of programs, and associated data files, to their credit. Moray Firth Software have operated more modestly, but nevertheless effectively, in producing two fully documented programs with other major productions in hand.

The interesting aspect of both groups is that they are private, self-supporting ventures with the members meeting in their own time. Both groups have engaged their own programmers, one by the simple expedient of advertising in the local paper.

Whilst official development projects and education authorities have given moral support and, in both cases, some very modest financial help, neither is an official working party or under the auspices of, or direction of, any central or local government authority.

The hope is that it could stimulate other groups to form and thus spread the guerilla network of small localised self sufficient groups.

The basis of both groups is that they will not be out of pocket and hopefully make some money. Moray Firth Software asked their programmers to quote a price for which they would produce a program to match the specification given and to reach the standards laid down by the Scottish Microelectronics Development Programme (SMDP).[5]

To summarise, the conditions necessary to establish and develop this approach to software production and hence CAL are:

1. Some intensive, motivational activity that brings like-minded teachers together from a subject area.
2. Enough of the teachers to be in geographical proximity to each other to form a team that can meet regularly. Four to six is probably the ideal size.
3. Continuing encouragement and probably some financial pump priming in the early stages. At the same time, the group members need freedom of action. Total independence of any official project is probably best.
4. The group need to own their own hardware and to meet in their own time to establish a clear claim to the copyright on what they produce.
5. Freedom to test their programs on pupils in their own schools as a pre-pilot and necessary development exercise.
6. An organisation, such as SMDP in Scotland, to take over programs when they are virtually finished, and distribute them. Agreed royalties to be paid to the group against sales or the copyright bought outright by the distributors.

A number of groups such as those described above, if spread throughout the country, can do a lot to stimulate further interest, encourage CAL and provide invaluable support to in-service work for teachers.

The third CAL strategy is called "mass conscription". By that is meant an attempt, through a prepared kit, to operate a diffusion model that, by stages, reaches into every geography department in the secondary schools of Scotland.

A complete kit[6] has been produced including a substantial number of selected illustrative examples of commercially available software. With this kit and appropriate hardware, in-service courses can be mounted throughout Scotland, with common objectives and materials.

The process of diffusion is planned in three stages. The first is to train the "trainers" by means of courses held in three colleges of education. The courses will introduce lecturers and advisers in the social subjects, including geography, to the kit and examine strategies for using it effectively on stage two courses. These advisers and college lecturers conduct stage two courses at suitable venues throughout Scotland attended by, at least, one social subjects teacher from each of the 400 secondary schools (Fig. 2).

The teachers who have been on these courses, supported by advisers and lecturers, will use the kits to carry the message to the other social subjects teachers in their schools.

If the strategy can be carried through as planned, there should be an awareness throughout the social subjects, including geography, of CAL's potential. Individual teachers can then make professional judgements based on knowledge as to where, when and how often to incorporate CAL into their work.

The fourth strategy is called "The Commando Tactic" and is the gathering together of an élite with special skills and using them for a clearly specified purpose. The current embargo on development work in schools in Scotland (Dec. 1985) has made normal interaction with the teachers and pupils in pilot schools impossible. Development funds have however been allocated and are lost if not used during a particular financial year. This led to a search for other means of collecting the necessary guidance.

To this end a two day residential conference was organised to which were invited social subjects curriculum experts from a wide range of institutions. This very experienced, high powered group were set a number of broad questions to which answers, or at least the best opinions available, were sought. Syndicates were formed and a number of intensive discussion sessions held.[7] While it cannot be claimed in any way to be a substitute for pilot work with schools, in these difficult circumstances it has enabled development momentum to be maintained. This, admittedly élitist approach, could have value as an addition to school pilot work in future, especially in developing a philosophy and rationale for a project.

In addition to these official and semi-official CAL initiatives there are a considerable number of geography teachers who have written programs for use by their own classes. Such initiative is called the Independent Operator Most are small, simple, but nevertheless most effective pieces of software frequently used in imaginative pupil centred ways. Ian Hardie of Mackie Academy in Grampian Region is a good example of this approach, showing that even the early Sinclair ZX81 can be used effectively with young secondary pupils. In Fife Region, Jim Birney has written a number of sophisticated programs to cover a wide range of geographical topics, but none have been published. Unfortunately for other geography teachers, he wrote for the RML 380Z micro which is only used by a few schools in Scotland.

FIG. 2

Scottish Social Subjects Micro In-service Kit[8].

Specific Objectives of the Kit

Computers in Learning

Teachers will be able to:

1.1 describe the features of Computer Assisted Learning Techniques e.g. Drill and Practice, Tutorial, Problem Solving, Educational Gaming, Simulation, Information Retrieval;

1.2 select suitable teaching strategies to match the objectives of a CAL package;

1.3 make critical use of software packages available in relevant subject areas;

1.4 produce a series of lessons to accompany a suitable CAL package;

1.5 identify the features of Computer Managed Learning;

1.6 identify the principal sources of CAL material.

Computer System Awareness

Teachers will be able to:

2.1 correctly use common computer terminology;

2.2 identify the components of a basic computer system;

2.3 describe the functions of components identified in 2.2;

2.4 assemble those components identified in 2.2;

2.5 load, run, copy and, where necessary, edit software on the assembled system.

Computers as Tools

Teachers will be able to:

3.1 demonstrate basic word processing techniques;

3.2 identify peripheral devices relevant to subject areas, e.g. Robot arms, graphics tablet, joysticks, light pens, concept keyboards, tele-text adaptors etc.

Strathclyde Region has had a number of geography teacher computer groups that have been active in reviewing software and one, in Dumbarton Division, has recently combined with Jordanhill College of Education in Glasgow, to produce a series of programs on models in geography.

This is not an exhaustive list of independent initiatives, far from it, but despite all the good work being done, it is disappointing that CAL has not made more rapid headway among Scottish school geographers.

The major difficulties can be summarised under the following headings.

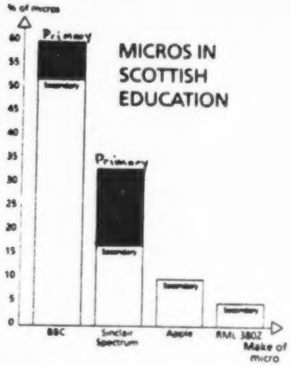
Hardware

Every secondary school and virtually every primary school has a micro-computer. In the case of the secondary schools, there are many with over ten micros and some have more than twenty. An increasing number have networks established in computer laboratories or have free standing machines in a similar situation. A substantial number of micros in a school does not, however, mean that a system is readily available to the geography department.

A number of us are concerned that the situation may, at the present time (early 1986), be getting worse, not better for geography departments. As computer studies becomes an examination subject, under the Scottish Examination Board for the first time, there is a danger that the supply of micro-computers in schools will be centralised under the control of the developing computer studies departments.

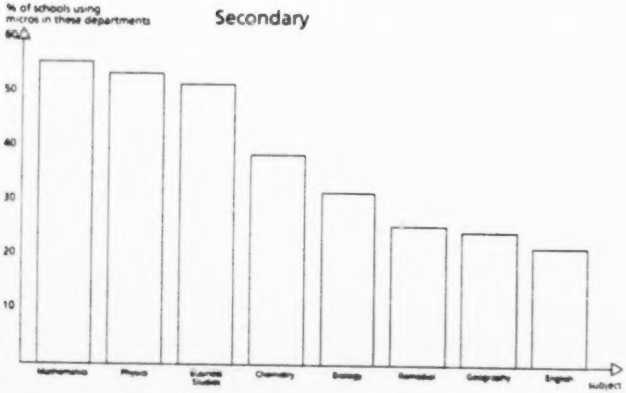
Established users among geography teachers will, no doubt, manage to maintain easy access to a micro-system, but it may be more difficult for someone just starting to consider CAL seriously in their geography teaching to get extended access to a system.

FIG. 3



Estimated totals of micros at 13.12.84.

SUBJECT USE



Source: 'Computing and Microelectronics in Scottish Education' September 1985, SCET.

Over the last two to three years the BBC/Acorn micro, with disc drive and colour monitor, has become the dominant system, despite its drawbacks of only 32K memory. Prior to that there was a variety of machines used, but the APPLE II was probably the most common, although by no means found everywhere. The RML 380Z, which has proved very popular in England, never became established in Scotland, except in Fife Region.

This lack of a clear cut national policy on hardware, since micros appeared on the scene in the late 1970's, has posed severe problems for development projects as indicated earlier. Program developers have been faced with the prospect of being required to write versions for three or four different micros which did not necessarily have the same capabilities in handling programs.

The move to BBC 'B' recently at least solves that problem, although its small memory does not make it entirely suitable for geographers who want to handle and analyse substantial quantities of data and run quite complex simulations.

At the same time as the secondary schools in Scotland equip themselves with BBC 'B' micros, the next generation of 16 bit micros are beginning to arrive on the educational scene. These machines, at prices comparable to the 8 bit micros, seem to offer what the geography teacher really needs, i.e. plenty of memory, speed, excellent graphics and colour.

A solution favoured by a number of geographers in Scotland, who are involved with CAL, is to let computer studies departments have the BBC micros which are excellent for teaching about micros and for programming in basic and then for the geography departments to have a 16 bit micro such as an RML NIMBUS. There is a difference between the machine needed for teaching about micros and the one needed in a curriculum area such as geography.

The Scottish Council for Educational Technology has recently published "Micro computers in Scottish Schools: A National Plan",[9] which, despite its title, is only a series of tentative proposals at this stage. It does, however, urge standardisation in the operating system, if not the micros, as 16 and 32 bit machines come into schools.[10]

Work with peripherals such as the light pen, graph plotter, graphics tablet and mouse is still at an early stage as far as geography is concerned. A current project [11] is looking at this whole area and will be offering guidance and making recommendations in due course. As with the whole hardware side, the situation is so fluid that almost any pronouncement made is out of date almost immediately.

Software

The vast majority of software being used in Scottish schools comes from the British publishers such as Longmans, plus a number of more specialist software houses, such as Netherhall and Tressell[12]. The Geographical Association catalogue lists 224 separate items of software extending across the age range, from about 10 through to 18 or 19 year olds.

Within Scotland there are a number of items that are available which have not been published on a U.K. or wider basis. SETTLEMENT UNIT[2] is the most widely used, having sold over 200 copies within Scotland. The Computer Development Group's wide range of data matrix and file based programs have recently become available on a commercial basis and may therefore become known over the U.K. and beyond.

The whole structure of software production for geography in Scotland, its successes and limitations, was outlined in the first section of this paper and needs no further expansion here. The continuing problem is to find quality programmers to work to geographers' specifications, at prices that education can afford. The general opinion in Scotland is that only limited and slow progress can be made if we rely on geography teachers learning programming. The software we require increasingly demands sophisticated programming which involves languages such as Pascale or machine code for quality graphics. CAL cannot take off on "homespun" or "cottage industry" programming.[13]

If the new micros free us from many of the present technical limitations, there still remains the price hurdle. Software produced cannot cost more than about £30 or it is beyond the budgets of school geography departments, however good and relevant it happens to be.

Teachers' Response

While many of us are disappointed at the relatively muted response to CAL in the geography classroom, it is not unfair to claim that geography is in the forefront of applying micrcomputers in the curriculum. Whilst there are notable exceptions, such as Hardie and Birney, mentioned earlier, it is true to say that the major uses of software have been with older pupils, especially the 16-18 age group. At this level, the pupil groups are smaller and pupils can work independently, often using programs to analyse data they have collected for projects such as the Higher Grade Practical Exercise in geography or Certificate of Sixth Year Studies fieldwork.

Most of the very real problems that arise have been discussed earlier in the paper and cannot be dismissed. Teachers have not been the ultra-conservatives or reactionaries in face of the new technology that some might claim. They have made sound judgements on the current value of CAL in relation to other available methods and technology available, and not perceived overwhelming advantages to compensate for the logistical, technical and cost difficulties faced.

In-service courses for geographers have been run at all levels from a National In-service Course at Aberdeen in 1983, through regional initiatives staffed by advisers and college of education staff, to teacher groups and school based in-service work for individual departments.

The latest initiative of a comprehensive in-service kit for use throughout the social subjects,[6] we hope will reinforce work already done and ensure that the message reaches all geography teachers in the country.

A useful overview of current Scottish geography teacher opinion is given in the report from the geography group, referred to earlier, that took part in the residential conference in 1985.[7] The following is their report, edited by G. Gardner of Strathclyde Region.

Geography Group Report

Reporter - G. R. Gardner

1. Classroom Strategies

To ensure a satisfactory level of use of available computer equipment, a range of strategies must be adopted. It is important that such equipment, if made available to Social Subject departments, does not gather dust in cupboards. Teacher attitudes underpin any change in teaching strategy and consequently staff development, at different levels, will be essential to ensure maximum application of microtechnology by social subjects teachers.

(a) Whole Class Activities

There are particular sequences in the social subjects generally and in geography in particular which can be presented to greatest advantage on computers.

These would include

- diagrams built up on computer and displayed to the class
- dynamic processes which can be illustrated effectively on computer.

Essentially the computer is being used in such instances as an electronic blackboard (such sequences could also be used with groups or with individual pupils). If several computers are available within the social subjects departments (see 2: Supporting Resources) then these could be used in the one classroom provided that networking was available.

The idea of a computer lab or computer suite is finding favour in many schools and may increasingly do so with the introduction of Computer Studies at O/S Grade. It will be important for school designers to bear in mind lessons learnt from the situation regarding language labs with the resultant inflexibility of use of both the laboratory and the equipment contained therein.

Nevertheless such labs could be used by social subjects departments to e.g. demonstrate data base enquiry and Prestel or run particular dynamic sequences with pupils.

(b) Group Work

The geography group concluded that, at least in the foreseeable future, it is in group work activities that the most important potential for micrcomputers lies. The computer unit, consisting of micro, disc-drive and VDU would be one of a range of teaching and learning resources also including listening posts, overhead projectors (to be used directly by pupils) and 'diastar' slide viewers.

It is in this context that pupils would be involved in different activities, differentiated either in terms of level of difficulty (e.g. in a core/extension/remediation structure) or in terms of different aspects of the one topic. In addition to performing certain data manipulation, the computer, through simulations and information access, will function as a focal point for discussion.

(c) Individualised Work

As in all that has been discussed above, the nature of the individualised work will be dependent on the quality of software. However, the computer can provide different levels of ability by, for example, a simple alteration of variables and software can therefore be matched to the ability level of the individual pupil. Individual enquiry using the computer as a data base and tutorial types of programs are other possible examples of individual work. Such 'enquiry' or 'tutorial' activities could be undertaken in the school library as part of a school programme developing information skills.

(d) Independent Work

Even at this early stage of computer use in the social subjects, some senior pupils are already developing their own programs. For example, programs have been included in practical exercises submitted to the SEB. As younger children in the primary school are increasingly exposed to computers it is conceivable that independent work involving the writing of programs could be undertaken in S1-S4 geography.

Point related to these teaching strategies.

1. As in all sections of work, the need for computer use and related software to be planned in detail into the teaching-learning programme.

2. The desirability of associating certain computer activities with co-operative teaching.

3. The possibility, through the introduction of computer based activities, of encouraging social subject departments to work more closely at a time when co-operation could:

(i) ensure survival of the subject areas as an important element in the curriculum.

(ii) assist development of multidisciplinary aspects of courses S1-S4.

(iii) enable a stronger voice to argue for enhanced allocation of resources in individual schools.

2. Current Situation in Schools

(i) Weaknesses

(a) Hardware

- A series of problems are related to the diversity of microcomputers in schools. These include incompatability of hardware and software and the different sets of commands.

- Social Subject departments have traditionally had limited access to microcomputers in part related to the monopoly of equipment by certain departments or 'enthusiasts'. Booking systems (e.g. for the computer room) can be restrictive, though if the syllabus is organised bookings can be made well in advance. The allocation of one micro to each department would overcome problems of access.

- Certain problems of maintenance are associated with the movement of computers.

- Many Social Subject teachers have not had any 'hands-on' experience of micros.

(b) Software

- Few authorities/schools take account of the resource ratio of hardware to software necessary to ensure optimum use of micros.

- A major question exists over the educational value of much of the software which has become available. In addition, the quantity of software has meant that it has not been possible for teachers to examine the full range. Reviews are often limited and programs occasionally 'hidden' by subject classification. Utility programs are not normally reviewed.

- The cost of many software packages prevents departments from obtaining these.

- There seems to be a reasonable number of programs for courses appropriate at S5-S6 levels, and with the development of many programs for the primary sector, a substantial 'gap' in software appears to have emerged in the Social Subjects S1-S4.

(c) Teacher Attitudes and Classroom Management

- Teachers are not unanimous in welcoming new technology. Some are afraid of the technology; others of course have a negative response to technology of any kind; others fear the possibility of many pupils being expert in an area that the teacher is not.

- Teaching styles which are didactic do not lend themselves to methodology involving microcomputers in an interactive manner.

- Many teachers lack the necessary skills of classroom management which are necessary to ensure best use of micros. This, in part, is related to the lack of proper staff development.

(ii) Strengths

When microcomputers are used effectively in geography departments

- they are most useful additional aids to teaching and learning, which offer considerable potential in particular areas (simulation, information access - including Prestel).

- pupil motivation is sustained for a longer time than might otherwise have been possible.

- pupils can progress at their own pace.

- pupil-teacher relationships are often improved and, on occasion, the pupil may be found assisting the teacher.

- they provide situations in which pupils appear to be more willing to discuss particular points or wider issues than would otherwise be possible.

3. Development and Implementation Policy in Relation to Micros in the Social Subjects

Reflecting the structuring of the discussion in the previous section the geography group considered the topic in relation to:

(i) hardware
(ii) software
(iii) staff development

(i) Hardware

It is recognised that the Social Subjects Microcomputer Feasibility

Study can have no direct access to policies on the allocation of micros to schools and to departments. Extensive use of micrcomputers in Social Subjects cannot be undertaken at current levels of provision. Current practices (introduction of computer labs/suites) associated with Computer Studies can counter "whole school" use of computers. However the continued increase in the number of micros in schools should ensure easier access to all members of staff; indeed it is to be hoped that each department will, in due course, be allocated at least one micro. This would allow the Social Subjects, working in concert, to have the possibility of several micros available in the one classroom if required. In addition, one printer and certain peripherals could be held centrally by the Social Subjects departments.

(ii) Software

The geography group identified the development of software appropriate to the S1-S2 course as an important aspect of the development programme. This could be achieved by the two-year secondment of teachers to work with professional programmers from SMDP in an effort co-ordinated by the Social Subjects Microcomputer Group. There are possibly three elements in the development of software:

a) Identification of areas of development for software within the S1-S2 curriculum - where possible of an 'open-ended' nature, that can be used by any of the Social Subjects.

b) Specification of program structures (including adventure programs, modular programs) by seconded teachers with subsequent development by professional programmers.

c) Identification of data sets for aspects of the S1-S2 syllabus.

(iii) Staff Development

It will be necessary for all staff to gain, in the first instance, 'hands on' experience. Consequently the main focus for in-service/staff development is likely to be school-based. Therefore 'learning packages' will be required to allow LEA/schools to organise in-service as they see appropriate.

At the basic level the in-service package should consist of:

- a video demonstrating the range of uses of computers and extracts of teaching-learning situations to encourage interest, particularly amongst staff who may, until now, have shown little enthusiasm for micros.

- samples of 'good' existing software of wide application within the Social Subjects.

- examples of associated pupil materials

- short booklets on aspects such as : Data Processing, Word Processing etc.

At a different level, videos or slide presentations might examine, in some detail, a range of teaching and learning situations. Accompanying documentation (including pupil materials) would allow social subjects teachers to try out the methodology.

Research Needs and the Future

1. Despite quite large sums of money spent on computing, relative to amounts spent on other aspects of education, there is a shortage of readily available microcomputers for use by geography teachers.

2. The rapidly changing technology makes standardisation difficult and adds to the problems of developing effective classroom strategies.

3. Computers still tend to be surrounded with a mysterious technical language and complex techniques that, whilst they excite some, put others off.

4. Only in the last 12 to 18 months has the supply of readily available software increased considerably. Although very cheap by business standards, it is still expensive in relation to the budgets of school geography departments. The ratio of money available for software in relation to hardware, is far too low.

5. It has to be shown very clearly not only what C.A.L. is good at, but how it is better than any other method. If this cannot be done why should teachers take the trouble to use it?

6. There is still a need to identify precisely what type of software geography teachers really need and then ensure it is produced. This requires money and scarce resources.

7. Effective classroom strategies have to be demonstrated which enable teachers to use C.A.L. within the constraints of the syllabuses and the school timetables. In many respects the Scottish primary school offers much better opportunities to use C.A.L. than the secondary school.

8. We must be clear in our minds on the criteria to be used to judge effective and sufficient use of C.A.L. Is it once a week with every class, once a term, regularly or in bursts with long lapses between?

In conclusion, the following list is put forward as basic criteria for the effective use of C.A.L. in school geography.

1. *Ready availability of appropriate and sufficient hardware without the need to re-organise the timetable to gain access to it.*

2. *Confidence and competence to operate the hardware, including dealing with minor technical problems.*

3. *A lesson timetable that allows C.A.L. to be used effectively.*

4. *Geography department awareness of the range of software available and ready access to it.*

5. *Software available that extends the range of teaching and learning by being more effective than alternative methods.*

6. *The ability and confidence of the teacher and pupils to make a conscious and reasoned decision on how and when to use C.A.L. and its appropriate integration into the learning situation.*

Those of us involved in C.A.L. in-service training for geographers in Scotland are attempting to tackle the problems listed above and establish the criteria. Some we can tackle directly, such as teacher confidence and competence, others, such as hardware provision, we can only lobby and speak out when the opportunity presents itself.

Notes and References

1. The Scottish Examination Board (SEB) is publicly funded and offer 'O' grade, 'H' grade and Certificate of Sixth Year Studies in the full range of subjects including Geography. Alternative syllabuses were introduced in Geography for 'O' and 'H' grade, they have now replaced the "traditional syllabuses".

2. Jennings, J.R. in Graves, N. (ed) (1984) "SETTLEMENT UNIT" p.136-146. Computer Assisted Learning in Geographical Education

3. Jennings, J.R. and Smart, N.M. "SETTLEMENT UNIT" : Aberdeen College of Education and Scottish Curriculum Development Service 1983: available on application to the authors if outside Scotland. Approximately £20

4. Jennings, J.R. and Smart, N.M. (1983) Micro-electronics and the Social Subjects: Proceedings of the Scottish National In-service Course Aberdeen College of Education £1.50

5. Scottish Microelectronics Development Programme : SMDP Interim Presentation Standards, SMDP, Glasgow.

6. Micro-computers and Social Subjects In-service Kit (1985) Moray House College of Education, Edinburgh. £100

7. Jennings, J.R. and Munro, R.K. (1985) The Way Forward: Report of a Conference held 7th/8th March 1985 : CCC/MEC publ., from Aberdeen College of Education £1.50

8. In Scottish education these look like being the RML Nimbus, the new range of BBC machines and possibly micros like the Atari 600.

9. M.E.C. "Micro-computers in Scottish Schools: A National Plan" (1985) S.C.E.T.

10. Ibid p27-35.

11. Micro-technologies and the Social Subjects: MEC/CCC Development Project 1985-88. Directors - J.R.G. Jennings and R.K. Munro.

12. For comprehensive lists see:-

    a) Fox, P. (ed) (1984) List of Geography Microcomputer Software Geographical Association, Sheffield.

    b) S.M.D.P. (1984) Social Subjects Software Catalogue, Scottish Microelectronics Development Programme, Glasgow.

13. See Self, J. (1984) Microcomputers in Education, Harvester Press.

THE USE OF COMPUTERS IN THE TEACHING OF GEOGRAPHY IN ENGLAND

W. Ashley Kent

England

Geography was one of the early subjects to show interest in the use of computers in teaching and this momentum has not been lost. As educational computing in England has developed and changed, so has the use of computers in geography. The literature mirrors these changes rather well. The seminal work by Shepherd et al (1980) bridged the period between the mainframe and microcomputer and still has pedagogic mileage left in it - a real testimony to its quality in a period of rapid change! The next generation of literature included Kent (1982), Kent (1983), Graves (1984) and in particular Watson (1984), in which a series of case studies showed how microcomputers were being used in geography classrooms. Most recently Kent (1986a), and Fox and Tapsfield (1986) aim at informing and enticing geography teachers to 'come on in, the water's fine!' Shepherd (1983). Developments can be easily traced across the pages of the Computer Page in Teaching Geography since April, 1983 when that feature was first introduced. Change in the ways of using computers in geography teaching have been both exciting and bewildering. As yet there is little evidence of the pace of change slowing down. The most important recent development is the imminent start of work on an INSET pack (start date, September 1986*) to include video tape and computer programs as well as the usual documentation aimed at encouraging geography teachers to act.

The 'Neotechnic' era of computer assisted learning (Hall et al, 1982) in England has now ended and owes most of course to two major elements of government policy. On the one hand was the Department of Trade and Industry policy from June 1981 onwards to support the purchase of British

* Michael Milton and Philip Webster are the recently appointed teacher/research fellows. For 1986-7 Michael is to be based at the University of London Institute of Education and Philip at the School of Education University of Bristol. Mathematics already has such a pack and geography will be the second subject to have one - a fact not without significance.

microcomputers by schools. This undoubtedly transformed the numbers and types of micros in schools. On the other hand was the Microelectronics Education Programme (MEP) (1981-6) with the aim of 'helping schools prepare children for life in a society in which devices and systems based on microelectronics are commonplace and pervasive' MEP (1981). MEP had a three-pronged strategy: resource support in which the 14 regional information centres were established; teacher training; and curriculum development in which projects and software publishing were supported. In essence this could only be a pump priming exercise since 'averaged out each school might therefore indirectly expect to benefit by some £100+ per year by the consumption of services either at a training or at an information centre' Hall, (1984).

A thorough evaluation of MEP's work has yet to be conducted but some early thoughts were assembled in the editorial of the Journal of Computer Assisted Learning (December 1985). The comments there are largely critical but it is this author's view that on a relatively shoestring budget the MEP has achieved a great deal if only to alert the educational world to the vital nature of educational computing.

In July 1985 the Education Secretary made the following announcement:

'I propose to set up a new body, to be called the Microelectronics Support Unit, which will provide support to local education authorities in a number of clearly defined areas, namely, the provision of a central information service; the training of trainers; and the development of relevant curricular materials for use in schools. The Government will also support, through the new Unit and the existing regional network for special education, the further development of microelectronics in this field. The provision of in-service teacher training and the supply and dissemination of local and regional information will be the responsibility of local education authorities in the course of their normal provision of education services. These decisions have been taken after consultation with a wide range of bodies'.

This new unit (the MSU) has a budget of £2.2m a year which is pitifully small given the national needs for co-ordination of educational computing. An uncomfortable change over period between MEP and MSU has been experienced in 1986 and a real start by MSU will probably be in early 1987. The final significant piece of government policy was also announced in 1985 and involved support on a £ for £ basis (like the Department of Trade and Industry support for the purchase of microcomputers) for the purcase of software by LEAs (Local Education Authorities).* How LEAs will respond to this and what impacts will have are not yet known.

HARDWARE

In the early days there was a confusing array of micros in schools but the dominant make was soon the RLM 380Z. By now however the picture has changed. BBC B micros are dominant (the manufacturer claims they are 75% of all micros in schools), with the 380Z Spectrum and 480Z present in much smaller quantities.

Now the majority of micros have disc drives; colour monitors; and printers. Most schools have at least one laboratory and/or network which means that one or more free standing BBC or 380Z micro can be used by geographers. Indeed some, and an increasing number of schools, have humanities departments and sometimes even geography departments with their own microcomputers. Unpublished (1984) surveys by Hall, Kent and Wiegand for Greater London, the West Country and Yorkshire showed how the average number of microcomputers per secondary school increased from 2.39 in 1982 to 4.84 in 1983. More recent estimates have spoken of 15 or even 20 being the equivalent figures for 1986. These are not unrealistic figures since TVEI (Technical and Vocational Educational Initiative) courses have enabled (relatively) lavish funding of micro-laboratories and networks in those schools involved in the schemes. The hardware position is now clear. What is less clear however is how long the preeminence of the BBC B will last and what replacement(s) will come to dominate British schools and when that will happen. Paradoxically enough England with its early start in CAL, not least because of the strengths of the BBC B micro, might well be held back in the near future from changing over to more modern 16 bit micros because of the inertia exerted by the BBC B micros in schools and the great volume of related software that has emerged. Although TVEI, computer studies and computer awareness courses taken up the lion's share of computer time in schools, it is this author's view that access to micros for geography teachers is not the limiting factor it once was. On the other hand the perception of the geography teacher may well (possibly inaccurately be that it is still a major constraint).

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*The DTIs support for the Educational Software Scheme is a deliberate attempt to stimulate software-buying by LEAs and independent schools. It puts £500,000 into the hands of LEAs and independent schools during 1985-6 with a further £2 million in 1986-87 and £1 million more in 1987-8.

SOFTWARE

There are a variety of wasy of looking at the types of software and associated learning brought to geography by the use of computers. Fox and Tapsfield (1986) point to seven contributions which the new technology can make to:- language development; numeracy; graphicacy; information skills; simulations including decision making; geography projects; and the new curricula in geography such as CPVE and GCSE as well as the more subject specific developments such as Geography 16-19. However the majority of existing software can be classified into three major types of learning. The first is where information is described, handled, displayed and analysed such as GEOBASE, QUEST and WELF. The second is the use of the strategy of simulation either for a model and/or system e.g. PUDDLE or a decision making situation e.g. FARM. The third involves the reinforcement of skills e.g. MICRO-MAPPING 1 and knowledge e.g. OS QUIZ.

The process of software development has been described elsewhere (Kent, 1984a). It is still characterised by a variety of producers from on the one hand teachers turned authors, to one the other hand the biggest agency (Longman). The timelag in the whole process - from idea to production to teacher awareness to purchase to use in the classroom - is still considerable in spite of adverts from the publishers and information given by the computer page of *Teaching Geography*. It almost seems that teacher awareness of the programs on offer is caught in a time-warp while at the same time the range of programs on offer inexorably expands. In 1983 the Geographical Association's list of software listed 76 programs. By 1984 Fox's list numbered 165. The pace of software publication seemed to slow momentarily in 1980 and 1981 but if anything has accelerated since then. Longman's 1986 catalogue for instance includes the following new programs - DIY MICRO MAP; CLIMATES; SAND HARVEST; GEOBASE; PEOPLE ON EARTH; and RIVER STUDIES. In addition Longman has just released a range of programs originally published in 1979 (e.g. MILL, DEMOG and FARM). The contrast between these new versions and the old point up the improvements in software published over a mere handful of years. Programs now have improved screen designs; rely on detailed colour graphics; are more user-friendly; provide more succinct teachers notes and often student resources made easy to duplicate; are either in an A4 format (Longman) or an A5 format (Heinemann and Nelson) both neatly enclosing disc and documentation. Another trend has been the linking of programs to syllabuses and books (e.g. CITIES 1 and 2 related to GYSL syllabuses and GROWTH related to the Geography 16-19 Project). Software production has become much more market orientated by becoming more relevant to a range of ages, abilities, and courses. As Wood, (1984) puts it, 'Much of this software has been criticised heavily for lack of professionalism, poor packaging, low teaching content, a patronising approach, bad instructions and no motivational value, but because there is so much that is shwoing such pioneering energy, standards are bound to rise quickly; driven by competition, plagiarism and the feedback from the market. This market is very well informed'.

Book publishers are still the dominant force in software publishing and their learning curve has been steep. However some new agencies have moved into this area including the BBC (for instance the INTRODUCING GEOGRAPHY series of four programs linked to top primary/lower secondary levels). Software publishing is seen as a potentially (but probably not yet realised!) lucrative venture which perhaps explains the British Council's recent role in promoting British software. (British Council, 1985). Software sales at home have been disappointing and the publishing industry is hoping that the DTI software support scheme will boost what at present only amounts to a £1m or so annual turnover. Equally uncertain is how the market will react to more expensive software now that MEP subsidies have run their course. Most problematic is the need to inform, rather better, the teaching force as to the software now available and its particular strengths and weaknesses.

THE RESPONSE OF THE TEACHERS

In spite of all this activity in software production, the emerging literature including journals/magazines (e.g. Educational Computing and Journal of Computer Assisted Learning) and the growing expertise through initial teacher training and INSET, all evidence suggests that take-up by geography teachers has been disappointing. Unpublished research work by Hall et al (1984) and Kent (ongoing) suggests that teacher attitudes are cautiously positive about the new technology. The paradox is of course that this rhetoric is not matched by action. Many have expressed interest and their intention of beginning CAL in the near future: 'We would like to start CAL next term' and 'If I stir myself we mar make more use of CAL in geography in the future'. Others were concerned abou the constraints and limitations of this innovation, '.....not enough time to bring it into the curriculum properly' and 'so far I've found material for geography very limiting at present'. As yet there are more 'tortoises' than 'hares' as Chris Simmonds (1985) puts it. However the conventional wisdom that the British adopt a Luddite mentality to new technology seems not to be borne out by the research of Mills (1985) though arguably some teachers do experience technostress - that is the stress felt by employees when new technology is introduced and the patterns of their working lives is upset.

LEA geography/humanities advisers who are in a position to influence take-up of the new technology, give a consistent impression (Kent, 1984. unpublsihed) of being overstretched, harassed and ill informed, relying stornglу on a local teacher 'geo-microperson' (David Hall's term!) to help with the limited INSET that has been possible. In any case, other research work (Bolam et al 1978, and Burdett, 1985) suggests that advisers sadly in this author's view, are not necessarily key influences on innovation policy in LEAs anyway!

What has been observed, (Wiegand, 1984) is that 'the geography teacher who does' (Kent, 1984b) adopts three styles of classroom management: whole-class teaching; group-work; and a cafeteria arrangement.

A further emerging trend has been geography teachers beginning to use data either from published sources or from fieldwork. (Freemand and Tagg, 1985). 'Generic' or 'content-free' or as David Riley (1986) suggests 'general purpose' software is starting to be used. The QUEST family can be used for both purposes. Lawler (forthcoming) has pointed to four types of programs used in fieldwork: statistic packages such as SUPASTAT; graphics packages such as ECOSOFT; simulation programs such as DRAINAGE; and data storage packages such as SCAN. Hopefully the new generation of hardware and software could cope with all four types!

RESEARCH NEEDS

Geography is to this author's knowledge the only subject in the school curriculum where some attempts have been made to co-ordinate research efforts. Twice yearly seminars are held at the University of London Institute of Education and several pieces of research are completed (e.g. Cummings, 1984; Hassell, 1982; Burdett, 1985; Freeman, 1981; Grummitt, 1978; Leonard, 1984; Thomas, 1985; Cracknell, 1985; Robinson, 1982; Abbott, 1980) or ongoing (e.g. Lawler, Dove, Goble and Rogers). It is possible to categorise this research (Kent 1984c) but classroom based, teacher-conducted action researches have understandably been most common.

The ESRC has made some efforts to sponsor such research. For instance an International Research Seminar on Computer Assisted Learning in the Social Sciences and Humanities was held in London in April, 1986 - (see Kent, 1986b) and Bob Lewis at Lancaster University has been made Co-ordinator for the Information and Technology and Education Programme (ITEC). The latter has a great deal of potential, in this author's view so long as its prime focus is on research not at the tertiary level but at the primary and secondary levels of education. On an international level the IGU Commission on Geographical Education, sponsoring this publication, has the potential to initiatie important international research after its next meeting in Sitges, Spain (Late August 1986). Important ongoing sponsored research is being undertaken by Freeman (the Chiltern Region Information Handling Project) and Wiegand (the use of spread sheets).

The summar this author can make about research into CAL geography reads like an end of term report, 'satisfactory progress but much more could and needs to be done!' The needs are endless - case studies of the processes of learning in CAL geography classrooms; what management strategies could be adopted to ensure greater take-up; the potential of modelling for CAL and geographical education etc. etc. The reader only needs to glance at the 'research needs' sections of papers in this volume to appreciate the scale and variety of such needs.

THE FUTURE

Educational computing in England can be portrayed as a system with a variety of component parts such as government policy, software and hardware all of which are rapidly changing and in themselves are difficult to predict. For instance, what is the likely hardware scene within the next five years:- will the BBC in its existing or upgraded form continue to hold an important place? Will the RML Nimbus dominate? What is the future for IBM compatible micros? It is a brave and probably foolish person who tries to predict this. The job of the futurologist is made impossible when the wider 'system' of educational computing is considered. It seems to this author that an unlimited range of future scenarios are possible.

With that in mind this author would go along with the recent relatively conservative predictions made by Fox and Tapsfield (1986). They suggest what possible innovation both general to education and specific to geography are likely to occur over the next ten years.

GENERAL INNOVATIONS

TECHNOLOGY

Increase in:-

1. Quantity of hardware available
2. Accessibility to microtechnology for pupils and teachers

3. Ease of use and versatility of hardware
4. Memory capacity and amount of data storage
5. Accessibility of large databases:
    i. within school
    ii. within the home
    iii. in life in general - libraries, shops, travel agents etc.
6. Awareness of potential by teachers, pupils and parents
7. Involvement/interest of parents in use of technology in schools.

INNOVATIONS/DEVELOPMENTS IN GEOGRAPHY

In the Geography Department, the next ten years will see the following technological developments appearing and increasing in their role and value:

1. Databases and related information technology systems for collection, storage, retrieval and display of data.
2. Modems to access data from outside schools
3. Word processing for teachers and pupils
4. Use of imagery from satellite transmissions, processed by micros
5. Use of microtechnology and data logging devices to collect, store and retrieve fieldwork data
6. Interactive videodisk for film, text and graphics
7. Electronic communication links
8. Use of commercial software packages
9. Integration of software
10. School computer networks/laboratories of micros

Of particular interest to geographers is likely to be:

- the emergence of general purpose software such as spreadsheets made so much more possible with the new generation of 16 bit micros such as the Apple Macintosh.
- the potential of new GCSE syllabuses as vehicles for the new technology - sadly the syllabuses do not seem to have grabbed this opportunity.
- the role of viewdata such as PRESTEL to enable geographers to link up with the world of information.
- the impact of the Domesday Project on the use of interactive video in schools. Also the role of the DTI funded projects directed by Bill Plummer through the National Interactive Video Centre will be critical if this innovation is to take-off.
- the use of satellite imagery in schools. Already several schools have receiver 'dishes' and a Geographical Association working group is active in this area.

The future is challenging and exciting. Many possibilities are at this stage very much at the research level but with potentially great spinoffs in the more distant future. In this category this author would place:-

- Modelling systems e.g. DMS (Dynamic Modelling System) originally developed by Jon Ogborn and now implemented for geography by David Riley and Terry Goble
- PROLOG, though geography as yet does not have such enthusiasts as Ennals and Nichol.
- Intelligent software such as the industrial location system being developed by Terry Goble.

In this writer's view the greatest spinoff from the use of the new technology could be the pedagogic reappraisals necessary. The environment for learning is invariably changed by the presence of the technology. CAL simulations are a good example of this, whereby formerly transmission-response learning becomes almost inevitable cooperative learning in which teacher and student share in a more equal partnership.

Even when all this is said however the widespread implementation of these changes has not occurred.

The essential conservative system in England has so far eluded any management efforts to bring about these changes. Take-up and take-off at times seem to this author, as far away as ever. Constructive policy recommendations to change all this are made by Fox and Tapsfield (1986) pp. 42-7. They direct the recommendations to:-

- geography teachers, heads of departments and headteachers
- advisers, inspectors and teacher trainers
- educational planners and bodies at national level.

For the new technology to be integrated with geography curricula, all the above 'actors' need to play a part, and act on these recommendations. The production of the Geography INSET pack (mentioned earlier) should be a most constructive help to geography teachers. Teachers after all were found by Armsey and Dahl (1973) to be the greatest single impediment to the introduction of educational technology in the classroom. As yet they remain to be convinced!

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SOFTWARE MENTIONED

INTRODUCING GEOGRAPHY	BBC
CITIES 1 and 2	Nelcal
GROWTH Longman	Longman
GEOBASE	Longman
QUEST	Advisory Unit for Computer Based Education
WELF	Longman
PUDDLE	Longman
MILL)	Rewritten Longman
DEMOG)	
FARM)	
DIY MICRO MAP	Longman
CLIMATES	Longman
SAND HARVEST	Longman
PEOPLE ON EARTH	Longman
RIVER STUDIES	Longman
MICRO MAPPING 1	Nelcal
OS QUIZ	Bourne
SUPASTAT	Huddersfield Polytechnic
ECOSOFT	Advisory Unit for Computer Based Education
DRAINAGE	Advisory Unit for Computer Based Education
SCAN	ILEA

SCHOOL GEOGRAPHY AND COMPUTER ASSISTED LEARNING IN THE UNITED STATES

FROM SIMULATIONS TO DATA BASES

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U.S.A.

Recent issues of subject matter journals in geography have carried helpful articles and timely reviews about computers, computer software and their relationship to teaching and lerning basic geographic concepts. The growing importance of microcomputers and the increasingly abundant production of software make such professional reading essential if teachers are going to be informed about education's most rapidly changing area. Everybody in the schools knows that they should be doing something more than they are presently doing to utilize computer assisted learning (CAL). That is especially true of those in social science education including geography. There is, however, both confusion and uncertainty about the role the computer should play in the curriculum. Part of that results from the fact that the computer has often been thrust upon the classroom teacher without adequate orientation and in-service experience. A recent study by the National Centre for Educational Statistics (1984) indicates that since 1980, the number of computers in American schools has quadrupled. Of the more than 80,000 school districts in the United States, at least half are now making some use of the computer, and the number grows each month. Geographic educators are understandably anxious because they confront a maze of questions to which there are presently only fragmented and inconclusive answers. The most basic is: Who is in charge? In the early 1970s, when American educators began to take the computer seriously as an instrument having curricular implications, Local Education Agencies (LEA) made computer instruction the exclusive responsibility of their mathematics departments. Some LEAs gradually began to realise that computer utilization was broader than mere equipment familiarization and literacy. They recognised that the computer could be an instrument in formulating and solving problems from a wide range of disciplines. In the long run, then, it was destined to belong to the whole curriculum, not just mathematics. Thus began a reorganisation that frequently included either a separate department of computer instruction or a teacher/administrator designated as a coordinator or director of computer assisted learning.

Since 1980, many American secondary schools have approached CAL with this organisational model that is both more efficient, since one person functions as a facilitator, and less expensive, because one coordinator is far more cost effective than a whole department structure. What has resulted generally through such an organisational pattern is the creation of computer laboratories under the coordinator's management for use by all the departments within an LEA. Thus, computer education is being placed in a context that is beyond its original purvue as a mathematics department responsibility. American education is recognising that CAL has a special role to play in many disciplines across the curriculum. Through their recently created school district coordinators, teachers are starting to learn that the computer can be an effective instructional tool for their students in everything from learning the rudiments of English grammar and geographic place location to the sophistication of higher order analysis in the physical and social sciences.

In such an academic environment of change and ferment, how are geography teachers to respond responsibly, especially since relatively little of the software available for purchase is in their discipline? Sheryl B. Robinson (1982) clearly identified the dimensions of the problem. She reported that most of the current computer software packages are for mathematics and that in the majority of instances, these programs utilise drill and practice techniques to elicit the recall of factual information. While it is true that some are very sophisticated, most do not teach concepts or involve students in the higher order skills of critical enquiry. With such narrow subject area coverage in mathematics, geography teachers cannot expect miracles in their subject area. A casual review of computer software in the 1986 inventories will verify that little has changed; drill and practice activities predominate. Even though there are increasing numbers of games and simulations, these often have an unfortunate emphasis or are too time consuming and difficult to be of much value.

Well developed drill and practice programs can serve an important need in geography classrooms. Not only do they individualise instruction, but they present students with basic information about places in the world, including relative and absolute location, topography, climate, political boundaries, and longitude and latitude. Some programs even cover such cultural topics as the typical clothing, housing, occupations and foods of the populace. SATELLITE DOWN: RESCUE ADVENTURES IN GEOGRAPHY by Frederick Burggraf (1986a) is one of the better programs of this type. Drill and practice activities may also be effective in vocabulary building. A word skills program to help students learn essential geographic terms (Burggraf, 1986b) provides users with a basic foundation in the vocabulary of geography. It assists students in learning the more difficult geographic concepts encountered in geography and social studies. Both programs are for middle and high school students.

Many teachers are contemptuous of drill and practice programs which are little more than electronic paper and pencil activities. In response, some school software specialists have gone into the development of both games and simulations. Each serves a different purpose.

GAMES AND SIMULATIONS IN THE TEACHING OF GEOGRAPHY

Games: The educational game is a computer technique that places the student in a competitive situation not unlike those in the popular, commercially produced home television games. On an individual or team basis, students accumulate points and in the process learn concepts and skills that broaden geographic knowledge. These games might have a student or team roll dice on the computer, move to an appropriate space, and answer a randomly selected question from categories built into the game structure. In a game about Africa or the Middle East, players might be introduced to major landforms, rivers and lakes, and major cities. The object of such games, of course, varies. Usually it involves capturing the most squares on the electronic game board or winning the most points or beating the clock. Alan Backler's FLIGHT PLAN (1984) is among the best games in geography because it is conceptually sound, intelligently conceived and well paced. Teachers are often critical of the gaming approach because students get so caught up in winning, the real purpose of the activity is lost. A game like AGENT USA (1984) is a fascinating competitive experience full of mystery and intrigue as it leads players across the world in hot pursuit of a villain. However, all that remains for most youngsters at the conclusion of the game is the happy memory of the challenge and intrigue. Geography becomes a vanishing afterthought.

Simulation: Simulation programs take a different route. The computer presents the student with a model complete with rules, resources and instructions. The purpose is to challenge the user to predict and test a real world system. Students can thus study the full spectrum of problems in geography ranging from differences in environmental perception about some imagined place to the economic and social implications of political strife among the leaders in a country. Thus users are confronted with critical situations that need resolution. To add complexity, the teacher often has access to the program so that variables may be added.

A prototype of a computer simulation is ANNAM - STUDY OF A DEVELOPING COUNTRY (Roessler, 1983). Although not designed as a geography program, the effective application of principles from geography is necessary for the student to be a successful user. The leader of a country is trying desperately to survive in office and students have to deal with a number of real-life situations. There are:

1. an unpredictable military élite commanding a small, but discipline army
2. a variety of special interest groups in each of the social classes, and
3. several formidable political rivals at high levels.

To complicate matters even more, the small nation is receiving aid from a superpower and is also engaged in a bitter struggle with an aggressive neighbour. In order to remain in control, the leader must not only manage the political situation in the country, but must also effectively and responsibly exploit its resource base. This means keeping the fragile infrastructure intact while trying to find markets for raw materials abroad and investors for new developments at home. Working through a simulation like this encourages students to use geography in understanding the contemporary world and how it has an impact on the interdependence of peoples and nation states.

However, the level of sophistication, coupled with the time it takes to work through the simulation, discourages most students and teachers from becoming participants once they learn what is expected of them. Because in most American schools there is a clear emphasis on covering the curriculum, few teachers are willing to surrender class time to using the computer for simulation like ANNAM, no matter how great its value. This type of inductive inquiry is usually considered a luxury. While simulations may increase student understanding of complex and sensitive global issues, these experiences do not do much to expand factual knowledge.

Another mitigating factor is the level of difficulty of most simulations. The true measure of their success occurs when students develop their own models to test hypotheses and challenge assumptions. Sadly, few geography students in American secondary schools have either the training or the background to accomplish such feats of application, evaluation and synthesis. While simulations may show computers at their best in presenting complex situations in a manageable format, the ability of students to analyse and elect appropriate options is generally absent. Therefore in most schools, the sophistication of simulations precludes their use as an effective learning tool.

DATA BASES IN THE TEACHING OF GEOGRAPHY

Data bases have been used in the teaching of geography for many years. Originally, they were in bound form and represented a considerable amount of printed material. Sometimes called Facts and Data About the World, they continued to swell in size as more and more information became available.

Being in published form, they were expensive and became dated quickly, espeically during the period of the 1960s when new nations were appearing on the map of the world with regularity. As a result, data bases in published form are seldom used in secondary schools.

The introduction of the microcomputer has made the reintroduction of data bases possible. The data base, once structured, is a rapid way to retrieve information about the nations and regions of the world. There are numerous reasons for using data bases in teaching, and especially in the teaching of geography (Pollak and Breault, 1985). There are seven which are particularly important:-

1. Information about the nations of the world may be arranged in more useful ways. For example, population data may become the major criterion in selecting nations from a region within a specific population range. The population density per unit of arable land might then become the important analytical variable, determining which nations among the selected group have higher populations in proportion to arable land.

2. Determining if there are certain commonalities and differences reflected by the data for the nations within a region or subregion. The degree to which the nations within a region share religious or economic similarities may be determined. The per capita income for the nations of a region also provides a measure of the economic well being for the region in general. Anomalies to the common observations may also be determined.

3. Relationships between nations of the world and regions of the world are revealed using data bases. The relationship between per capita

income and population density may be examined closely for a number of nations to determine how the two variables interact.

4. Trends which develop in a region over time may be analysed. The data base is also beneficial in searching out trends. For example, the age structure of the population provides information about the future demographic characteristics of a nation. Similarly, calorific requirements being met and population pressure on arable land, combined with population change data provide information with which the student may project general trends.

5. Data bases permit the testing and refining of hypotheses. Evidence which may be used in support of a hypothesis is one of the important benefits of data bases. For example, students may develop a hypothesis that per capita income in a nation is low due to the high population density. The data may verify that the income is indeed low, but that the population density is also low. The students must now apply additional information from the data base to restate or refine the hypothesis.

6. The organisation and availability of information is enhanced since data bases provide a structure. In geography the data are available in their spatial structure, making research, analysis and generalisations of the variations of data across the surface of the earth possible. The fact that spatial data are available and may be used in a variety of ways to address a number of problems may be one of the important learnings for the student in a geography class.

7. Data bases help maintain information which is current. Data bases provide the most recent information from the most reputable sources.

In geography, much of the information which is usable comes from governmental reports, United Nations data sources, and organisations which are the gate watchers for certain global or international conditions. These sources represent the best data available and are usable, with certain clarifications to the student (Hunter, 1985).

DESIGNING DATA BASES

The criteria essential to data base design are:

1. Ease of use. The data base must be easy to use. Lengthy and complicated protocols necessary to access the data are discouraging to the student and don't contribute to the learning. The initiating of the data base must be clean and neat. Once the student has entered the disc on the microcomputer, the orientation to the student should be brief and things should get underway.

2. Focus on geographic learning. The objective in using a data base is to to enhance geographic learning. That objective is easily subverted and the focus can become the mastering of technical details about the computer and the software. Computer techniques is a secondary objective at best. Geography is the principal focus.

3. Ease of manipulation and retrieval of data. Students need to be able to identify, retrieve and manipulate the data they are using with ease. The data base must provide students with the opportunity to readily locate a specific information, or the data base may not be as valuable as a publication which contains similar data, but in bound form.

4. Control over information presentation. Students should have a degree

of control over the ways in which they present the information from the data base. This extends beyond the display either by printer or monitor. The students need to exercise decisions in developing national profiles, in arranging data tables for visual comparison, and in graphing and plotting various elements represented in the data base. The presentation of data need not be completed in its entirety by the computer. Students should also use data from the database in mapping and graphic display in conventional ways.

The World Data Base (Stoltman and Liolios, 1986) was designed with the preceding criteria as a guide. The students engage in the comparison and analysis of data about 181 nations or political units in the world. There are twenty-six variables available for each place. The study may begin by making a Nation Profile, as shown in Figure 1, or by listing any of the variables for any political unit.

A second enables the student to compare different nations on selected variables, as shown in Figure 2. All nations in a region may be compared by any of the variables, or nations in different regions may be compared on a variable or combinations of variables. The results of such a comparison is shown in Figure 3. At this point in the use of the data base, the student is expected to make comparisons and analyse the differences and similarities among the nations (Traberman 1983). The examples included are only a minor segment of the opportunities for regional analysis which the data base makes possible.

CONCLUSIONS

Two observations can be made about computer assisted learning. One is that most teachers do not trust the computer, largely because they do not find the available software programs complementary to their curricula. Thus they use them either as silent tutors, feeding information of someone else's making to their students, or as a reward for high grades or good classroom behaviour. Students are then presented with learning games and simulations that raise the computer to the level of entertainment. In this setting, the student plays rather than works, with little effort by the teacher to measure what the student has learned. In addition, most of the rewards are only marginally connected to the curriculum, and students use the computer largely in a discontinuous and unconnected manner. A computer does not allow a teacher to estimate progress which a workbook or laboratory manual might permit. The computer gives the teacher little opportunity to diagnose student problems or assess progress.

This leads to the second observation. Computers have had only limited success in the geography curriculum, not just because of the general inadequacies of the software and teacher suspicion, but because computer assisted learning has not been integrated into the overall course of study. Integration occurs in mathematics and to some degree in the physical sciences. Software has been either too simplistic (drill and practice) or too sophisticated (games and simulations). As a result, except for administrative purposes like record keeping, attendance and grade reporting, most teachers view the computer as both a burden and a threat.

Can computers teach better than teachers? Will the computer depersonalise learning? If the computer becomes so commonplace that every classroom has a station for every student what will happen to student socialisation which most teachers agree is an essential component in the educational process? These are important and sensitive questions that must be approached on two levels. First the research provides no definitive answer about the computer's ultimate effectiveness. Investigation thus far has been on too small a scale to be conclusive and research has not specifically addressed geographic education. A partial answer is offered by a report from the Northwest Regional Education Laboratory (1982). The report shows that in all subject areas, computer assisted learning contributed to higher student achievement when it supplemented traditional instruction and was recognised by teachers as being a regular and legitimate element in the classroom. However, broader and more comprehensive studies are necessary to show the instructional value of the computer.

The second dimension of the question raises a serious and significant philosophical issue. No matter what the task or the subject area, when students use a microcomputer, they interact with a machine rather than with their teacher or their peers. This is especially critical in social studies disciplines like geography, where one of the priorities is successful social interaction. Teachers must weigh the benefits of replacing social experiences with technological ones and find ways to merge the two.

What must happen among teachers of geography and others who present courses in the social studies is a realisation that the computer is just one of the many learning tools available to teachers. Presently it is generally viewed as a burdening device that intrudes upon the day-to-day operations of the classroom. This attitude will only change through improved pre-service and in-service programs. These must be designed not only to teach the value of computer assisted learning but also to persuade teachers that the computer will be as essential to the learning establishment in the next century as the revolution in audio/visual education has been to this one.

Curriculum decision makers and teacher trainers must recognise that the computer has the potential to make two abiding contributions to social studies education presently missing in American schools. First, because there has been a failure to achieve an effective integration of the various disciplines that crowd the social studies curriculum in increasing number (e.g. ethnic and minority history, consumer education, women's studies, education about substance abuse, et .), significant efforts must be undertaken to build bridges between and among all the disciplines within the social studies. Social studies educators including those in geographic education must begin to develop a consensus on what content to select and emphasize. Geographers have already developed a helpful model in the Guidelines for Geographic Education (AAAG, 1985). The impact of this endeavour is becoming increasingly clear as school boards, administrators and teachers recognise that training in geography provides unique perspectives about places and their relationship to each other over time. Moreover, a knowledge of geography is rapidly achieving status as an essential ingredient in the total process of educating informed citizens.

Citizenship education has always been a priority of the social studies in American schools. Its role and purpose have changed regularly to respond to the country's special social, economic and political needs. These have included industrialisation, urbanisation, immigration and intensifying patriotism in times of war and crisis. Now citizenship education has assumed a new dimension. No longer does it suffice for a person to have only a basic knowledge of the role of citizen in the national commonwealth. The fragile interdependence of peoples and nations around the world imposes the need for an understanding of a global citizenship. If any order is ever to be brought to the eclecticism that presently characterizes the social studies in American schools, the computer can serve as a key instrument. It possesses the capacity to store, categorise, pace and sequence information for students. Through the use of data banks, the components of the social studies can achieve a perspective never before possible. That sorting out is likely to lead to an assessment that global education can play a part in educating for citizenship.

The second contribution lies in the quality of materials that software designers must generate. Too often learning is neither engaging nor exciting, especially in the secondary schools where lessons are presented as largely passive experiences. Classrooms tend to be dominated by teacher talks with limited opportunities for active student involvement. Clearly a need exists for increased participation so that students can be more involved in their own learning.

Here the computer can also perform a vital function. To do so, programs must be better formulated and address those elements of the curriculum that will help students clarify and refine their own thinking. Through well designed programs, they are likely to achieve what the critical inquiry specialists call metacognition - the ability to be aware of one's own thinking and learning processes; in short, the ability to learn how to learn.

Against such a background, software developers must design their work. They must not only anticipate the shape of the new social studies but also develop products that will help fuse all the strands and threads that comprise it. And they must do this in ways that teachers can accept and which students will understand. This means avoiding oversimplification and the creation of program formats which allow the student to be an active learner. Additionally, software developers must create programs that ensure mastery and, at the same time, go beyond it to include problem solving strategies. This means that the student will be able to understand the larger concepts of causation, interdependence and interaction common to geography, history and all the social studies. At the same time, however, such exercises in computer assisted learning will help students discover that each discipline has a structure as well as a specific system of addressing and defining the issues that both afflict and challenge all societies in the contemporary world.

Regardless of the present deficiences in computer assisted learning in geography and the rest of social studies education, the promise of the future makes it eminently clear that the microcomputer is not a passing fad. Computer technology is already a part of the fibre of our daily lives. Because of their increasing capabilities and declining costs, computers will be an integral part of the American educational system well before the turn of the century. Indeed, the challenges are there for every subject in the curriculum. Outcomes will be determined in part by the technology and what the software designers do with it, in part by the evidence of the educational research, and finally by the attitudes and adaptability of the nation's geography teachers.

Fig. 1

NATION'S PROFILE

1.	COUNTRY NAME	Federal Republic of Germany
2.	LAND USE	33% cultivated 23% pasture 29% forested 13% other 2% water
3.	LAND AREA	233,219 Sq. Km.
4.	POPULATION	61,700,000
5.	POPULATION DENSITY	264 people/Sq. Km.
6.	POPULATION DENSITY PER ARABLE LAND	502.6 people/Sq. Km.
7.	ANNUAL POPULATION INCREASE	-0.2%
8.	YEARS TO DOUBLE POPULATION	population is decreasing
9.	ESTIMATED POPULATION AT YEAR 2000	59,000,000
10.	POPULATION UNDER 15 YEARS OF AGE	18.5%
11.	POPULATION OVER 60 YEARS OF AGE	14.8%
12.	RELIGION DISTRIBUTION	50% Protestant 45% Roman Catholic 5% other
13.	CAPITAL	Bonn
14.	GOVERNMENT LEGAL NAME	Federal Republic of Germany
15.	GOVERNMENT TYPE	Federal Republic
16.	LITERACY	99%
17.	LIFE EXPECTANCY	73 years
18.	GROSS NATIONAL PRODUCT	655,500,000,000 U.S. dollars
19.	PER CAPITA INCOME	10,672 U.S. dollars
20.	CALORIES PER CAPITA	133.4% of daily requirement
21.	ENERGY CONSUMPTION PER CAPITA	6,053 KWHRS
22.	T.V. RECEIVERS PER 1000	337.3
23.	NEWSPAPERS PER 1000	423.0
24.	EXPORT VALUES	168,700,000,000 U.S. dollars
25.	IMPORT VALUES	152,000,000,000 U.S. dollars
26.	GEOGRAPHICAL REGION	Europe

Fig. 2

Student is to compare three different nations on the following variables:

1. POPULATION
2. EXPORT VALUES
3. IMPORT VALUES
4. LAND USE

The nations are:

1. FEDERAL REPUBLIC OF GERMANY
2. MEXICO
3. NIGERIA

Fig. 3

Comparison Profiles

FEDERAL REPUBLIC OF GERMANY

1. POPULATION	61,700,000
2. EXPORT VAULES	168,700,000,000 U.S. dollars
3. IMPORT VALUES	152,000,000,000 U.S. dollars
4. LAND USE	33% cultivated
	29% forested
	23% pasture
	13% other
	2% water

MEXICO

1. POPULATION	79,662,000
2. EXPORT VALUES	21,339,000,000 U.S. dollars
3. IMPORT VALUES	7,720,000,000 U.S. dollars
4. LAND USE	40% pasture
	26% other
	22% forested
	12% cropland

NIGERIA

1. POPULATION	91,178,000
2. EXPORT VALUES	10,500,000,000 U.S. dollars
3. IMPORT VALUES	12,100,000,000 U.S. dollars
4. LAND USE	41% desert
	37% cultivated
	22% other

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THE USAGE OF COMPUTERS IN TEACHING GEOGRAPHY IN THE USSR

Lydia Pancheshnikova

USSR

According to the principles of Secondary and Vocational School Reform (1984) in the USSR, a widespread introduction of computers into the teaching process has started. The fundamentals of information science and computer engineering has become a compulsory subject in senior forms of secondary schools. Special requirements of computers to be used in schools have been worked out. The production and installation of a personal computer "Agat" in schools has begun and a new microcomputer for schools is being prepared for production. Modern Soviet computers "DVK-1", "DVK-2" and "Electronics BK-0010" have been installed at a number of schools. Programmable calculators are being more widely used in schools.

Using computers in the process of teaching geography in schools is a new problem. The attention of scores of scientific workers, college and school teachers has been drawn to its solution. The introduction of computers to the teaching of geography is possibly due to the fact that computers, besides being used for strictly purposes of calculation, are more widely being used in both industry and science for information services, modelling of some processes and documenting the results of this work. These possibilities provided by computers are exceedingly important for geography as a science and its investigations of complex natural and social-economic systems.

Existing computer programs in geography for schools are still experimental and are being evaluated. Most of them are used as a means of assessing physical and economic geography courses. Pupils are asked questions and their knowledge and skills are evaluated. The programs are based on objective testing. Some experience has already been gained in using computers for programmed learning when algorithms provide successive introduction of small units of the material under study and also provide control over the quality of a students' mastery.

The programs containing simulated models have proved to be especially efficient. They enable the user to reproduce a number of different situations, to show the influence of numerous factors which should be taken into account while solving the given task and to present various data in their textual, statistical and graphic form. Such programs make it possible to implement a problem-solving approach to teaching as well as the use of role play.

We think that equipped with such programs, computers have great advantages in comparison with the other forms of teaching aids. We reproduce below a fragment of one of such programs on the topic "Weather forecast" (for 13-14 year old pupils) as an example. Aims are : to sum up the pupils' knowledge about the climate of the USSR, to practice the pupils' skills of applying the previously attained knowledge about atmospheric processes and phenomena, to continue the process of forming the idea of interconnections between atmospheric processes.

An outline of one of the large regions of the USSR is reproduced on the display. The pupils are offered, after choosing a definite season (winter, summer), to select digital data, using climatic maps of certain atlases and textbooks and to feed it into the computer, thus determining a definite weather situation. Then the changes of the weather caused by intruding air masses; a cold or warm air front; a cyclone or an anticyclone; (the choice of conditions is optional) are modelled by the computer. The pupils act as weather forecasters. They forecast weather for a particular situation and give practical recommendations to the workers engaged in agriculture and transport. While doing it, the pupils themselves choose the sources of information, but in case of difficulties the computer advises them on the problem, varying the degree of help.

Using a printer the modelled weather forecast is printed out and the group of pupils reports and defends the results of its work.

In Soviet pedagogy, computers are considered to be one of the audio-technical aids, which should be used alongside more traditional sources of knowledge (textbooks, maps, films etc.). Computers do not diminish the role of the teacher in the teaching process but give additional opportunities of controlling pupils' cognitive activity.

As has been shown by observation of the lessons, the usage of computers, has a number of advantages: they provide a tempo of learning responsive to the individual characteristics of schoolchildren; they help to realise an alternative approach to teaching; they encourage school-children to work in teams; they provide the teacher with the assessment data on the knowledge gained by all the pupils of the class during a particular period of time. Working with graphic displays stimulates the pupils' interest. In some schools the senior form pupils having studied the course on Fundamentals of information science and computer engineering are enthusiastically working on the authoring of simple geography programs.

We believe that the use of computers for the teaching of geography in schools will increase as they help to make the teaching process more efficient.

The main trends of research investigation are : creating, teaching and testing programs of different types and evaluating their efficiency; investigating the influence of computers on the speed of pupils' learning different components of geography syllabuses and on the motivation of their cognitive activity; investigating the influence of the computers on the structure and organisation of pupil's work in geography lessons etc.

THE DEVELOPMENT OF CAL IN HONG KONG

Philip G Stimpson

Hong Kong

This paper describes the first steps in the introduction of computer assisted leraning in Hong Kong geography classes. In Hong Kong there are essentially two school systems. A Chinese system, which uses either wholly the Chinese language or part English and part Chinese. This provides education for over 98% of the population. Expatriate children, with a few local pupils, attend schools which are modelled on the system of their home country. These include British Army, English, North American, German-Swiss and French schools. In the schools of both systems, CAL has been slow to take off and this is particularly so in the numerically dominant Chinese system. However this paper focusses on the indigenous Chinese sector because it is more characteristic of the state of curriculum development in the Territory as a whole.

Shepherd (1983) suggests three significant prerequisites which shape the use of computers in the classroom. These are:- (1) the democratisation of computing (computers for all), (2) the commercialisation of computing (the supply of suitable hardware and, in particular, the publishing of software) and (3) the bureaucratisation of computing (national support by government and other institutions for the use of the computer in all its aspects). In Hong Kong there is neither the democratisation nor significant commercialisation of educational computing. Institutional support is patchy and Government, at the operational level, is still at the stage of maintaining computers in the hands of specialists. Notions of a society generally versed and practised in the ways of information technology remain as rhetoric, and the more restricted short term demands of the industrial lobby dominates. Thus whilst the microcomputer is seen as an exciting prospect for the geography classroom by a handful of people, the general situation in the schools remains bleak. As yet there have been no major attempts to include CAL in the armoury of teaching and learning tools in the geography classes of Chinese schools. On the brighter side, classroom experiments and workshops for geography teachers are taking place and the next few years may see a change in the situation.

In the late '70s, prominent industrialists in Hong Kong warned that the economy would lag behind its competitors in succeeding years unless the Territory sought to develop a more computer literate society. This view was strongly supported by academics of the two universities who commented critically on the slow pace at which the Government Education Department was instigating and resourcing courses in the schools. The Government, on its part, recommended slow and careful development and rejected any suggestion that it was dragging its feet. Indeed it is probable that the relatively conservative pace of development has enabled Hong Kong teachers to avoid some of the pitfalls which have befallen other countries. The Government planned a phased introduction of computers into schools. This began in 1982 and is described in more detail in the next section. Whilst hardware is being made available through this project, support in its use across the curriculum is limited. Curriculum development for all aspects of the school programme is centrally organised, and that for CAL rests within a committee dominated by traditional computer studies interests. Whilst resources are scarce and there is a need to prioritise, it is probable that this approach has slowed initiatives in discipline areas such as geography.

Hardware

The first phase of the Government scheme took place in 1982-3 and this provided 30 pilot schools each with 9 Atari 800 micros at a total cost of HK$1.0 million, each processor being equipped with a single disc drive.

Phase II of the Government scheme provided each of a further 75 secondary schools with 11 Apple IIe micros with single drives and with 2 printers. Phase III is under implementation and it is reported that the BBC B machine will be introduced into a further 105 schools. This will equip each of these schools with 11 micros and disc drives. Other schools, outside the Government project, have made separate arrangements by purchasing micros from private funds. For example one primary school bought 6 Texas Instruments machines. These have been used with top juniors for the teaching of languages and mathematics. Geography which is included in social studies and is not a major primary subject was evidently not considered. Other schools have adopted the IBM PC or IBM clones. Some schools have purchased other micros, such as NEC, for administrative purposes and these might also be used by a teacher wishing to take the first steps into CAL. The hardware pattern is highly confused with little standardisation. The Government has seemed to be at pains to distribute purchases across suppliers presumably not wishing to show favour in any one direction on the one hand and leaving the option open on the other.

In Hong Kong schools, unlike in some UK schools, there was no initial phase of mainframe use shared between institutions. As a result the innovation of the micro is seen as a prestige resource. Geography teachers must compete from the periphery with other subjects for the use of computers and geography teachers feel that access will be difficult. The problem of high summer temperatures and high humidity, which frequently exceeds 80%, necessitates air conditioning to maintain CPU stability. However few classrooms are air conditioned and, as a result of this and the need for security, micros are installed centrally as fixtures in specialist rooms. These facilities are normally under the control of the computer studies specialists and access to other teachers, including geographers, is difficult. Whether it is true or not, geography teachers feel that in the main they would not be welcome. The attitude exists that non-computer specialists will be unable to handle micros, a view which has been compounded by servicing agreements which restrict use to specific personnel. In the face of such difficulties, some heads of department who would like to experiment feel their only option is to buy their own departmental micros. This almost inevitably will mean only a single micro if it is possible at all.

Software

Software used at present is only at a preliminary evaluation and experimental stage and even this may infer a level of formality which is not present. However a number of initiatives are intended or in hand. The Education Department of the Hong Kong Government is to set up a computer centre which will contain software viewing facilities. The Geographical Association has a committee for the interchange of information about available software. The Faculty of Education at the University of Hong Kong is in the process of building up a software library. The purpose of this is to (a) trial materials in order to advise local schools, (b) provide facilities where a range of software opportunities can be viewed by teachers on preservice and inservice training courses and (c) help teachers build up their knowledge and, most importantly, confidence to have a go in their own schools.

Hong Kong relies to a large extent on imported software and this is likely to continue for the near future. However up until recently there has been a reluctance on the part of overseas suppliers to fill the need. This was probably due to concern over copyright given the reputation of certain parts of the commercial sector. These imports are vital as local educational software houses are unlikely to develop because the local marked in Hong Kong is small and uncertain. Furthermore there is a shortage of available programming skills, most of which is concentrated in the more lucrative commercial and industrial sector. As a result there is very little local software for schools except for simple home produced drill routines. For example, one teacher has prduced a program to develop/test ideas about plate tectonics using SUPER PILOT. Whilst these programs are of limited classroom value, they are not without significance as they generate interest and understanding of what really may be needed. Their importance is in raising awareness and in teacher education. The main software need is for interactive simulations which contain graphics of a reasonable quality. These must be imported but have been difficult to obtain. Hardware suppliers now realise that their sales depend on the provision of suitable software and as a result have made efforts to remedy the situation. Probably not unrelatedly, holders of software are taking a more responsible stance with respect to copying. As a result the supply of overseas software is easing.

Teachers see their main use of computer software to support teaching in sixth form classes. This is possible because of their reluctance to relax the formal expository style which they use in the lower secondary school. Thus the aim has been to find programs which are suited to the A level curriculum which uses an ecosystem-landscape approach to the study of man-environment questions. Evaluatory work began two years ago and concentrated on the Schools Council Computers in the Curriculum suite of programs. Among these human population growth (DEMOG, Cooper , Kilberry and Watson) and drainage basin morphometry (BASIN, Knight-Branch and

Watson) elicited most interest primarily because of their general applicability. Since that time other of the Longman and Hutchinson software packages have been tried. Particular interest was shown in the program PUDDLE (Riley and Paterson) and in the MEP/CAPE Project Geography Programs DROPLET, COAST and LAND.

Simple drill programs such as INTRODUCING MAP SKILLS (Wells and Forecrest 1983) have also been used. Teachers concede that in an ideal world they could be useful for self paced pupil work and they could envisage using such programs for remedial work in form 4 where some pupils start formal geography for the first time after three years of social studies. However in general such programs have generated less interest because there are unlikely to be sufficient micros available for individual learning. Furthermore such programs can often be substituted by paper and pencil exercises.

Locally designed programs for undergraduate use have been examined for their applicability to A level teaching. At a recent workshop organised by the G.A., teachers ran a program designed to simulate air, noise and water pollution; a CAD contour package; and an application of DBASE to sort data from a tree survey. Whilst these are interesting, their authors felt that the programs were probably of marginal value for schools.

Questions of teaching style reflect teachers pessimism concerning resources. Teachers would like to see pupils working in small groups around a bank of micros, but in practice think that this will be unlikely except with small sixth form classes. Teachers would probably use a single micro linked to a large TV screen as a part of a guided learning style of lesson because of the shortage of resources and their reticence to use non teacher dominated procedures. Of the four models proposed by Shepherd et al (1980) the "gatekeeper" model seems the most likely style which teachers would adopt. In this aspect the Hong Kong teachers are very similar to those examined by Wiegand (1984) in England.

There is a general reluctance to experiment because teachers cannot see a direct link between existing software and either with the content stated in the Government Curricula or with their traditional expository style of teaching which stresses product rather than process. Further imported software does not contain Hong Kong examples. Consequently a program such as SETTLEMENTS proved interesting because it could be adapted for local use. This capacity to localise is vital in a Territory such as this where the establishment of regional identity is important. In the Hong Kong context, this means focussing on China. The question is cultural as much as it relates to working from existing knowledge of the pupil. The likely take up of CAL materials is as much a matter of teacher attitudes as it is of hardware and software supply. If the interest and demand is there, resources will undoubtedly be supplied.

The response of teachers

The attitudes of teachers demonstrate a conflicting dualism. Hong Kong is a society which prides itself on being modern and technocratic. It is a society where ideas are speedily taken up and the attitudes of teachers are no different. At the same time, there is a strong inbuilt conservatism which mitigates against risk taking and which venerates the status quo. Furthermore as in many developing economies, examination results are all important. The education system is tuned to matters of quantity rather than quality of educational experience. Rote learning is inbred into children from the kindergarten, as the means to gain examination success and to overcome difficulties of being taught in a second language. It is not suprising that there is a marked mixture of interest and scepticism.

One unit of the inservice certificate in Education for geography teachers comprises a lecture and workshop on the use of CAL. Participants were asked before the sessions to list 5 advantages and 5 problems they saw of using a computer in the geography classroom. Table 1 shows the response of the 19 teachers on the course. In general their responses are very similar to those found by Freeman (1983) in the U.K. The perceived advantages, or prospects, of the Hong Kong teachers fall into four groups. The first expresses the generally held view, popularised by business computer advertising, that the advantage of the micro lies in its ability to store, rapidly manipulate and vividly present large data sets. A second cluster identifies the micro as a means to increase pupil interest and satisfaction by providing results quickly and comprehensively and by adding variety into teaching style. A third cluster is also pupil orientated and indicates the way teachers feel the micro can increase the ability of the pupil to work. It sees the micro as enhancing pupil participation and independence, reducing their fear of statistics and providing pupils with answers quickly and easily. A fourth group stresses the advantages to the teacher when designing lessons. It sees the micro as a flexible device which can be controlled to select a desired outcome or to illustrate a particular aspect of a problem. At the same time if pupils are in difficulty or need challenging, problems are easily repeated or alternative questions easily set up. However among the replies in general it was aspects of data handling. interest stimulation and student participation which figured most strongly.

TABLE 1

PERCEIVED PROSPECTS AND PROBLEMS IN COMPUTERS IN THE TEACHING OF GEOGRAPHY, 1986

(Number in ( ) refer to frequency)

PROSPECTS

Interest and stimulation (8)

Ability to draw maps and diagrams (6)

Ability to calculate rapidly (6)

Improves pupil participation (5)

Ability to store large data sets (4)

Ability to process large data sets (4)

Saves time (3)

Provides immediate pupil feedback (3)

Provides a flexible medium (3)

Adds variety to lessons (2)

Increases efficiency in data handling (2)

Generates satisfaction

Increases independent work by pupils

Increases the ease by which answers can be obtained

Provides control so that exercises can be varied

Provides vivid presentation

Represents a new visual aid

Provides the capacity to repeat operations easily

Demonstrates all steps in an argument

Provides accuracy in handling data

Removes some of the fear of statistics

Provides an opportunity to apply the techniques of computer studies

PROBLEMS

Lack of equipment (9)

Lack of teacher ability to handle computers (9)

Cost (6)

Too time consuming to use in class (5)

Requires too much preparation time (5)

Lack of pupil ability to use a computer (4)

Lack of software suitability (2)

Lack of software availability (2)

Will reduce teacher-pupil interaction (2)

Problems of storing equipment

Not relevant to all topics

Involves too much concentration on the TV screen

Screen too small for use with the whole class

Limited involvement if only one keyboard

Extra lessons would be needed for computer training

Not enough time in geography lessons to run programs

School rules may prevent use by geography pupils

May lead to neglect of other skills

Does not involve real life situations

Lacks creativity

Lacks human warmth

Teacher will become neglected

May cause discipline problems

May cause boredom

May cause lack of interest as too difficult

Will generate too much involvement in computers in geography

Provides little potential to react to higher cognitive skills

The list of perceived problems is slightly wider than the prospects and again resolve into four groups. The first raises questions of resource cost, availability and suitability. This is undoubtedly a genuine worry but is likely to be self fulfilling in the absence of a will to implement. A second but related group involves questions of the competence of teachers and pupils to use a micro-computer. Teachers are concerned that, in an already crowded curriculum, extra lessons would be needed to familiarize puils with the workings of the micro. The third group focuses on the relative efficiency of using a micro with respect to teacher time and the demands placed upon pupils. It is felt that the use of computers may lead to the neglect of other skills or even to an emphasis on computing rather than geography. Teachers worry that the micro may stifle creativity and the pupil-teacher interaction which is necessary for the development of higher order cognitive skills. The fourth cluster stresses classroom management. Teachers feel that there may be boredom and a loss of discipline and of the warmth involved in human contact. In general the problems stress resources and classroom interaction problems.

After the workshop, course members were asked to re-examine their feelings and to indicate changes in attitude. In this particular workshop teachers had run the MEP/GAPE Project and the Computers in the Curriculum programs. Whilst some of the comments confirmed earlier views, changes were apparent. The additional comments were more specific reflecting greater awareness of the relative merits. They commented that many of the games were too complicated, might become ends rather than means, lacked real interest and relevance to Hong Kong and developed too few ideas for the time required taken to run the program. Teachers commented positively on the potential of the programs for consolidation because of the logical structure and the general quality of explanation provided through the material. The capacity to change situations and conditions generated a dynamism which was difficult to achieve in pencil and paper exercises. Related to this quality aspect was the view that the materials were good for the less able as they would give them a sense of achievement. Thus in general there was heightened awareness of the potential for using the micro.

Support for geography teachers in their introduction of CAL has come from two sources although others are being planned. The G.A. of Hong Kong recently conducted a one day course. It attracted 13 teachers and was run by a mixture of school and university teachers. The G.A. also intends to make computers in geography one of the foci of this year's annual conference. Geography teachers on the inservice and preservice Certificates in Education at the University of Hong Kong have received for the last three academic years some exposure through the lecture and workshop sessions described earlier. These are supplemented by using software at other appropriate times during the course, for example when the use of simulations is discussed. These opportunities for teachers are to be increased by running other one day courses and by helping to run sessions in schools.

The Education Department of the Government has not organised anything specifically for geographers although they support the initiatives described earlier. It is their intention to raise the general level of teacher computer literacy by providing courses for non computer specialists. The proposed curriculum of these courses will contain an element of CAL. The University of Hong Kong is similarly proposing that all students on the Post Graduate Certificate in Education take a basic computer literacy course. This would not concentrate on CAL but in the use of word procesing, spreadsheet and filing software. This would not be directed towards geography per se, but the development of such skills may provide the necessary basis of competence and confidence for other courses.

Research needs

CAL is viewed with mixed feelings by teachers. However, unless the conflicting attitudes are understood and accommodated in implementation programmes, the successful introduction of the computer into the geography classroom is unlikely. Questionnaire surveys of the type described provide some indication but greater insight is needed if the true feelings of teachers are to be understood. It is necessary to get inside the thinking of the average classroom teacher and to really know what are his or her worries and to discover the latent abilities that are possessed. Such deeper understanding can come from a series of case studies using an illuminative approach to research. It is probably only through this perspective that the information needed will be obtained. There is a role for teachers to undertake such research as a part of INSET and the higher degree programmes of tertiary institutions in the Territory.

Teachers are unlikely to experiment to any great degree until they have the confidence that lessons involving CAL will be successful. Part of this confidence will come from improving computer literacy of teachers and from increasing familiarity with software. However the major hurdle will still remain that of taking the first step in the classroom. Teachers need to see successful use with pupils. This could be achieved by an intervention study in local schools by a team comprising teachers, programmers and curriculum evaluators. If such a study were to be carried out, then information on different teaching styles using the computer could be documented and evaluated. At the same time this would provide the impetus to generate local software. Some software is being developed, for example programs using PROLOG (Ki 1986), but this effort will be wasted if there is not a suitable environment where it can be tested.

The future

Whilst most teachers are unfamiliar with computers in the classroom, the computer as an office tool is accepted. A large number of teachers already use word processors and are aware of file and spreadsheet programs such as dBASE, PFS and VISICALC. One way into CAL for geography teachers may be through business software, the usefulness of which has already been demonstrated by other workers. However one view is that the future for CAL is primarily dependent on changes in teaching style. Once student centred learning becomes more accepted, then teachers will look for a new range of activities for pupils. At present, as in many other places, "chalk and talk" dominates. Alternatively perhaps greater effort is needed to examine how CAL can support more traditional learning strategies. In 1986 in Hong Kong, CAL is a teaching and learning tool looking for ideas where it can be used. This is probably an inevitable first step but rapid progress will only come about when the converse applies.

Acknowledgements

I am most grateful to Mr W W Ki for the information on PROLOG and to Dr K C Lam for a report on the G.A. workshop.

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COMPUTER USE IN GEOGRAPHICAL EDUCATION IN CANADA

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Canada

Any discussion about education in Canada has to take into account that responsibility for education - the development of curricula and funding of programmes - resides with each of the ten provincial governments. Only the Yukon and Northwest Territories are under federal jurisdiction for education. As a result, both the position of geography in the curriculum and the pace and direction of the implementation of computers to education varies widely across the country. It is important to survey the policies and initiatives of the provincial governments with reference to both geography as a discipline and the broader topic of cross-curriculum computer use in schools. The state of development of computer use in geography is dependent to a great extent on the support given to cross-curricula applications in all subject areas in a province. These official attitudes also provide the framework within which the future use of computers in the teaching of geography can be projected.

Just as the policies related to computer integration vary provincially, the strength of the position of geography in the total curriculum is not consistent across the country. In the Maritime and Prairie provinces, geographical concepts and skills are addressed through broad based social studies programmes. British Columbia has an identifiable geography subject area governed by an appropriate provincial guideline. The guideline is currently under review - a process which promises to strengthen the role of geography as an intermediate and senior subject. However, the use of computers as a methodology or as a resource are not included in the *planning for the near future. If computers are to be used in the secondary schools of British Columbia for geography in the short term, it will be in scattered locations on the initiative of individual teachers.*

In Quebec, the geography curriculum is strong, but the situation with respect to computer access prevents anything but very isolated experimentation by individuals. Where activity for cross-curriculum applications is taking place, geographers are included but there is no provincial co-ordination from either the provincial education department or teacher groups.

Although the journey has just begun, a strong commitment from the Ministry of Education for Ontario for the integration of computers across the curriculum has led to progress on many fronts. In major statements and policy papers, the Ministry has indicated to the local school boards that computers are to be used by all students, not just for courses involving study about computers; rather, "Students will use these machines to do a variety of activities - analysis and reasoning exercises; simulation....word processing ....graphics" and "There will be two fundamentally different ways to use computers in the process of teaching and learning. The more significant way will be the creative use of the computer by individuals : writing, composing, designing, analysing and other extensions of original thought. .....All students must be given opportunities to use computers in this way". (Ministry of Education, Ontario, Memo 47, 1982).

A new geography guideline from which school boards will develop their courses is in the draft stage and will be distributed by early 1987. Consistent with the overall Ministry statements, the guideline incorporates more specific directions to teachers and school boards for the integration of computer use for the support of teaching and learning. "Geography teachers are innovators, not only in terms of classroom practices and *out-of-school activities but also in the use of a variety of equipment and media in the classroom. The advent of the computer into schools provides geography teachers with a powerful tool to achieve the aims of geographic education." (Draft Geography Guideline - Senior and Intermediate, Ministry of Education, Ontario 1986).*

Hardware

There have been three general models or strategies adopted by the provinces for the acquisition of hardware for use in schools. These models range from the relatively unstructured approach of the smaller provinces to an innovative and very ambitious strategy adopted by the two largest provinces.

In the case of the four Maritime provinces and the Prairie provinces of Manitoba and Saskatchewan, the decisions about the type of hardware and the source of funding have remained essentially in the hands of the local school district. The resulting mosaic of hardware types is generally dominated by Commodore and Apple machines with the former having an edge because of the significantly lower unit cost and the availability of sufficient non-commercial software to get a school started.

In the two western provinces of British Columbia and Alberta, the Departments of Education selected Apple computers as the provincial standard and paralleled that decision with an evaluation and distribution of software for Apple computers. While some Apple computers were made available at reduced cost, the reality at the district or school level has been that while a significant number of Apples have been purchased, other less expensive brands are appearing in significant numbers - the most common of these alternatives is the Commodore and more recently, the IBM.

The two largest provinces, Ontario and Quebec, have worked from the premise that none of the existing microcomputers on the market meet the very specific needs of education. Working independently, each province identified a set of functional specifications for an educational micrcomputer and then offered development money and guaranteed initial purchases to any company which would undertake to meet those specifications. In Ontario, this strategy has produced the ICON microcomputer which is now marketed internationally by Burroughs. The ICON arrived at a time (late 1984) when most schools already were heavily committed to Commodore and Apple computers but since it is 16 bit technology and supports a networked classroom environment, the ICON is a viable alternative to upgrading computer rooms or for new purchases.

With the help of signficant support funding from the Ministry of Education of Ontario, there are already over 11,000 ICONs in the 5,500 Ontario schools (end of 1985). In early February 1986, the Ministry approved IBM microcomputers, with some important upgrades, as O.A.E.M.s (Ontario Approved Educational Microcomputer). The upgrades enable the IBM PC to network on a Unix-like system and to have software level compatability with the ICON. It is too soon to assess the impact of this approval on computer purchases by school boards, yet it is clear that the Ministry hardware functional specifications have gained considerable credibility from IBM's efforts to meet them.

Quebec was later in starting the process of identifying and acquiring an exclusive educational microcomputer; but, the MAX 20E (product of Comterm and manufactured partly in Quebec and partly in France) is now available and an initial 9000 have been contracted for by the provincial government. The largely business office orientation of the MAX 20E and its software places in doubt the successful adoption of this computer into Quebec schools despite the current ban on the purchase of any alternatives. Any cross-curriculum situations which do exist involve traditional hardware bought before the government decision; but, since French is the first language of education in Quebec, schools do not have access to most software from the United States and much of that developed in other parts of Canada.

Software

The wide variation in type of classroom computers makes the software picture very complex. Further complicating the issue is the range of sources of software which geographers are using in their classrooms. Although computer assisted learning software comes first to mind when considering sources of software, a broader vision of the nature of computer use in geography opens up the possibility of additional categories of software.

First among these alternative applications is data base use. In geography, computer held and accessed data bases can take several forms:

i) major external data bases of current events or specialised collections of writings

ii) curriculum-related data bases created in advance at the provincial level, school district level or school level for classroom use

iii) data bases built by students either for their personal use or for class use, further subdivided for a single assignment or a course-long compendium.

The first of these data base forms is becoming increasingly available to geography teachers and their students as school libraries or resource centres acquire computer equipment and data base research funds. Geographers *have the opportunity to be first among their colleagues in giving students the opportunity to develop data base skills and to access key word search data bases for major projects. Although many of these data bases are relatively expensive for frequent school use, some providers are recognising the validity of the educational market. For example, INFOGLOBE, a data base which holds the full text of the Globe and Mail (Canada's only nationally distributed daily paper) compiled since 1977, is now available at special educational on-line rates. With many speciality sections and international reporting, the Globe and Mail provides an excellent source for a range of topics appropriate to the geography classroom. In British Columbia, the provincial government is giving some consideration to the future possibilities for CDROM data bases which can hold a complete encyclopedia and relevant visuals for social studies classes.*

In the second category, specialised geography data bases are just starting to appear as commercial software products. For example, a program developed by a group of teachers in Ontario, the GAP PROJECT, has as its core a data base of 47 variables for 146 countries of the world. Seventeen different statistical routines allow for searching, manipulation and analysis of either the whole data base or subsets. These options include graphing techniques, arithmetical operations and a work space for adding additional data. Consideration is being given by the same group for a similar program using a data base containing selected components of Canada's census.

The processes of classification and analysis of grouped data are valid topics for study at all age levels. Very simple packages which allow students to create data bases can be used at primary and junior levels (ages 6-11) e.g. PFS FILE for Apple, DATA MANAGER for Commodore and ICON. While the statistical manipulation is usually less specifically oriented to geography, standard data base packages allow intermediate or senior *classes to build up and then interrogate data sets from their own research or resulting from computer conducted questionnaires. WATFILE is an example of a very open-structure data base which permits reasonably sophisticated enquiry of both textual and numerical data.*

A second alternative application to traditional C.A.L. is the broader set of computer tools. Certainly data bases could be included in this list but their importance to geography merits separate attention. However, word processing, electronic spreadsheets, statistical packages and graphing packages can each be of considerable value to geography students. Since these programs do not deliver curriculum, it is necessary for both the teacher and the students to be trained in the use of the software and for class assignments to incorporate these activities. Most powerful among these applications are the combined packages which permit statistical analysis of data assembled in a data base package and then allow the resulting data to be represented on a map. While software of this type is beyond the capability of the lower cost and low functioning hardware currently in use, the advent of 16 bit machines and larger capacities has made it possible for geographers to begin use of these more sophisticated applications.

The third and most widespread application of computers to geography curricula is C.A.L. - a term which is applied loosely to software which augments or enhances the learning methodology and which presents activities in which the computer provides direction for or control on the learner as distinct from computer tools which are accessed as tools of research or presentation and in which the student takes the full initiative for planning and pace. C.A.L. applications are the most difficult to support in terms of software. They require more software since each package has a specific topic and therefore short period of relevance. They are also curriculum specific, requiring each subject to build up a unique inventory of software of use only to them. Added to these two limitations is the problem of bias, either cultural or curricular, which is inherent in any C.A.L. program and which limits the transfer of such software across international, or even regional boundaries.

Some of the software available to Canadian geography teachers comes from the United States. However, in most States, geography does not have as strong a position in the curriculum as it does in most parts of Canada. In addition, many programs are geared to drill and practice activities based on specific American information. Only a few simulations on general topics or global issues are of any value.

Educational software development projects in the United Kingdom have contributed a number of high quality programs in the field of geography, some of which are also highly local in flavour. Unfortunately, even those programs which have applicability to the Canadian scene and are of superior quality are very hard to obtain. Commodore and Apple versions, which exist for some of these programs, are simply not marketed to Canadian schools.

It is apparent that geography teachers here are largely dependent on national sources for really useful materials and to date the software development initiatives have been centred in the province of Ontario. The four major sources of software for education in Ontario have each produced a few geography programs and more are on the way. Commercial sources such as book publishers and software companies have responded to the strength of geography in the curriculum with products. The GAP PROJECT mentioned previously is an example of a product designed to accompany a specific text book but which also can be used in a much wider context and can be marketed on its own.

Individual school boards frequently support the software development ideas of their teachers and then make the products available to other boards at cost recovery basis. Only a few boards are large enough to set aside funds or have the support staff to supervise these activities so the products are few in number. An association of many of the largest school boards in the province (ALSBO) has set up a shared software project into which each contributes and over which each has some say about topics and types of software. Geography has been particularly fortunate in this project and has had several programs funded. These software packages become available to non-participating boards through a cost recovery basis in Ontario but the authors hold the copyright beyond the province.

The major initiative in the development of educational software has come from the Ministry of Education for the Province of Ontario. Prior to the completion of the first OAEM (Ontario Approved Educational Microcomputer), a call for software proposals resulted in the funding of 42 software packages for PET and Apple computers (not all geography). Since the ICON and now the IBM have been classified as OAEM, all subsequent development ($5.7 million in 1985) is to meet the specifications of those machines; but, cut down versions of some of these programs have been made available by commercial interests for 8 bit machines. Developers funded by the Ministry include commercial software houses and tertiary educational institutions as well as groups of teachers.

The most common type of CAL software used by geographers in Canada is the simulation. Some of these could be called course specific in that they were designed to link with objectives of the existing curriculum in a particular grade. Most widely used in the province is a series co-ordinated with the geography of Canada course for 13-14 year olds. The project has received funding from the Ministry, ALSBO and their own school board to produce 6 role-playing activities each dealing with a distinct economic activity in Canada e.g. NIAGARA FARMER and ATLANTIC FISHING. In taking the role of someone involved in the economic activity, the student or group of students have the opportunity to make decisions based on static data about the area and the job and variable data about the weather and the market conditions.

Also appropriate for the Canadian geography course is a Ministry-funded package called THE CANADIAN SHIELD RAILWAY. Students apply map-reading and interpretation skills to construct a railway through the Canadian Shield for the least cost and the least damage done to the environment. Two other Ministry-funded projects set up simulated environments for the urban geography student. URBAN ORIENTEERING (ages 11-14) allows the teacher or student to prepare a map resembling the local community. Students are challenged to find their way from place to place using conventional symbols to chart their route. A second urban geography program, SUBDIVISION PLANNER, requires students to plan a subdivision to accommodate a specified combination of family units within a space with specific characteristics. Somewhat similar in concept is the CANADA CAR RALLY, funded by ALSBO, in which students combine map reading and spatial strategies to most efficiently move between major points in Canada.

A pair of simulations aimed at economic, resource development or environmental geography topics has been developed under Ministry contract - ECONOMIC DEVELOPMENT. The unique aspect of these two programs is that they take advantage of the intelligent network structure of the OAEM configuration and have each of four roles - developer, financier, local and regional governments - played at separate terminals. Information and decisions made by one group becomes part of the simulated environment of the other roles as they collectively work at the development of a ski and holiday resort site or, in the second simulation, plan for changes in land use in a town. The network environment allows role playing to be independent of the social structures of the classroom but it does require at least four user stations in the one classroom area.

Because of the large stock of public domain software for Commodore computers and the corresponding lack of financial support for computer-using geography teachers, several pieces of software got early recognition and continue to be used because of the degree to which they have served the curriculum. POLUTE and LIMITS are simulations which came into the public domain in the United States because the original development was based on a grant fund from the federal government. Other less polished programs such as VOLCANO and HAMMERABI work well if supported by pre and post activities designed by the teacher.

The Response of the Teachers

The use of computers in Canadian schools is still very unevenly distributed and more critical to such use than the reaction of teachers, is the availability of hardware. In areas where schools have hardware resources beyond those needed for elective courses about computers, geographers are often in the vanguard of teachers who seek to use the technology to enhance curricular objectives. Several factors contribute to this leadership: i) the subject of geography is itself affected by advances in technology and the teachers as a result are often more in tune with the implications of computers in society, ii) geography classrooms are usually less formally structured than many others and the teachers are more ready to accept the high risk atmosphere in which new methodologies can be used, iii) new teachers have often used mainframe computers in their undergraduate studies and are therefore more generally computer literate, and iv) the subject of geography and the range of methodologies used to teach it are particularly suited to the use of computer techniques.

Nevertheless, those who make use of computers in their classroom are in the minority. There is a pressing need for in-service courses to prepare teachers for the integration of computers which is certain to become the major element of change in schools over the next five years. This in-service will come from various directions - school board training workshops, additional certification courses in computer classroom skills for cross-curricular applications and professional organisation conferences and workshop packages.

Because hardware exclusively for curricular applications is scarce, classroom teachers must make arrangements to take the class or a subset of the class to a computer lab. This usually involves negotiating a switch with the computer studies teacher and restricts the amount of time and the spontaneity of the computer use. As a result, simulations and data analysis which can be done in groups and which can be planned ahead are used most frequently. In settings where the school library/resource centre has computer capability, geography teachers incorporate external data base research as part of senior division projects. Where a geography dpeartment has acquired one or more computers for exclusive or shared use, the types of applications expand. Computer tasks can be built into a unit in such a way that students can do analysis or work on programs over time or when appropriate.

Geography teachers who became involved at the early stages often learned to program so that they could fix up public domain programs or create their own with the result that the wheel was reinvented in many basements on weekend mornings as each person tried to address his or her own needs. Very little of that low quality software is produced or used today as software inventories improve and it is certainly no longer an expectation that a computer using teacher will be able to program. Now teachers' first contact with computers, and often the only use they make of them for a while, is through teacher tools: marks managers, word processing, multiple-choice test builders and inventory programs.

Research Needs

There is far more to say about what should be done in preparation for the optimum use of computers in the teaching of geography than there is to say about what has been done to date. Research needs to be done as early as possible and should follow several directions.

Computers offer a new methodology for use in the classroom. Before we examine the impact of any specific software on the learning of children, it is appropriate to consider the nature of the medium itself in light of the readiness required to operate effectively as a learner in that environment. For example, very little is known about the ages and stages at which students are able to work with or attach meaning to abstract and symbolic forms of presentation fundamental to VDT display. Closely related to this research direction is the need to investigate student capability to solve problems with spatial dimensions at various ages and developmental stages including the ability to perceive patterns and relationships. If reports that many spatial skills can be developed at an earlier age are true, then there also will be a need to reassess the pace and order of the steps in the progression of those skills as they are currently taught.

Computer technology permits academic activities which will challenge our existing skill and concept progressions and create new ones. The extensive use of models and simulations in geography has a long tradition but, the openness and limitations of hand manipulated models provided a 'white box' *situation in which students were aware of the structure and range of the model. Models far too complex for hand manipulation now enable students to evaluate decisions and project change and pattern. Yet, computer based models are usually 'black box' in nature and students control input to observe output. Concepts and understandings previously implicit in open model activity must now be identified, sequenced and taught overtly so that students will learn to challenge the types of models and simulations which will be used to make major decisions in the world of their future.*

As a corollary to this research on models, it is appropriate to evaluate the use of models in geography classes in terms of what really is learned and how well those achievements transfer over to other curriculum areas. Since so many of the simulations available today seem to work best when students work in groups, consideration should be given to the differences between face-to-face groups and side-by-side groups in terms of communications, leadership patterns and group strategies for the task. Because the computer can act as an arbitrator for group discussions, it can be hypothesized that side-by-side groups will be less dependent on and restricted by existing social structures.

Some information exists on differences between genders in terms of their use of computers but most of such studies look at classes where computers are the object of study rather than the tool or agent of the study of something else. There are two aspects to the research question here. Are there real differences in the degree of success with computer use in geography between the genders and how much is that affected by the type of activity involved at the computer? As a separate but related issue, what differences if any exist in male and female attitudes toward computer use in geography and the attraction of geography as a subject if it makes use of computers? Further, computers may alter the interest of students of both genders in data or information in abstract and symbolic forms - such as data bases, graphs and diagrams, simulations, choropleth mapping.

The success of computer use to teach or promote learning has to be considered as a general concept. Investigators should attempt to identify concepts and skills that students appear to grasp more readily as a result of instruction using computers. One example would focus on the apparent improvement in judging the significance of variables thorough use of certain types of computer programs. Since computers are credited with bringing the brain hemispheres together on tasks, interesting observations may come from an examination of the correlation between right/left brain dominance and geographical/spatial thinking.

The whole area of data bases and their various uses in geography suggests a number of significant topics for research. It is appropriate to consider what subtle or overt logic and mathematical principles are inherent in the use of data bases. The results could indicate criteria to be considered in the design and development of data base software for geography. If problem solving skills are to be used or developed through the use of data bases, the structure of the software shell which provides the user interface with the data should enable and optimize logic sequences and mathematical relationships.

The linking of data bases and other tools such as graphing packages will require complex abstract shifts and references. The ages and stages of these skills should parallel or precede major adoption of these integrated packages. Preliminary to the study of the more complex relationships, the conceptual requirements of spreadsheets and data bases - key word, relational or linear format data bases - should be identified and set into progressions or sequences.

The Future

Computer use in geography classrooms has the potential to extend and enhance the subject through the creation of simulated environments over which students can have control, by facilitating in-depth research and analysis of original data and by providing a methodology which cuts through many tedious tasks that previously had to precede analysis and thereby make geography more fun to do as well as to study. Computer opportunities also promise to ensure greater depth of understanding and greater heights of skill development through its capability to pace the learning experience to the readiness of the student.

These promises are beginning to be realised to a limited extent in Canadian schools - primarily those in the province of Ontario. Current trends in the commitment of the responsible levels of government suggest that hardware is going to increase in availability and to extend beyond the computer studies classroom. As that happens, there will be a need for geography teachers to develop sufficient computer competencies to be able to utilise their share, or more than their share, of the available computer time. In the short term, computer using geography teachers will continue to be in the minority. However, when the hardware comes it will probably never be sufficient - strategies must be developed by classroom teachers to maximise a small resource base. But the hardware will come!

In anticipation, geography teachers, who lay claim to professional training in being able to read and project trends, should take every opportunity to acquire the skills and competencies which they eventually will need. Immediately, curriculum planners and geography teachers should bring their curriculum content up to date and reflect the impact of the technological age in studies of communication, transportation, employment structures and *third world issues. Associations of geography teachers - local and provincial - should set out a long term strategy to assist their membership in the preparation for and the implementation of computerised classroom methodologies.*

While hardware is the current roadblock to implementation, the overall key to the successful accommodation of computer applications in geography classrooms hinges on the ability of curriculum planners and teachers to integrate computer activities into the curriculum. It is unfortunate that in some provinces curriculum review is presently underway for geography and such computer planning is not incorporated. Software may be seen as an issue - but software is going to be developed for cross-curriculum applications but the money for that development will go to subjects where there is demand. Geographers and their curriculum leaders in Canada must create that demand with appropriate preparation.

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